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LIFE HISTORY NOTES AND THE EARLY DEVELOPMENT OF THE BONEFISH, *ALBULA VULPES* (LINNAEUS)¹

By JOHN E. FITCH
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The family Albulidae is an ancient one. Several fossil albulids are known from Eocene deposits throughout the world. Cockerell (1933) based an even more ancient species, *Albula antiqua*, on a scale from the Cretaceous of Florida. *Albula vulpes*, the present day representative of this genus, is world wide in distribution, being found in almost every tropical and sub-tropical sea. La Monte (1945) gives the range on the Atlantic coast of the United States as north to Cape Cod, Massachusetts. Barnhart (1936) says they are sometimes taken on the Pacific coast as far north as Monterey Bay, California. Myers (1936) reported on a specimen preserved in the Stanford Museum which was taken at Sausalito, San Francisco Bay. They are not, however, taken commonly along the California coast. Thompson (1919) reported taking with a "bottom net" numerous leptocephali of *Albula vulpes* in four to five fathoms of water off Long Beach, California by the California Fish and Game boat "Albacore." Other California records on file at the California State Fisheries Laboratory, Terminal Island, are as follows:

1. Four taken in clear water outside the San Pedro breakwater by a commercial fisherman, Carmen Scotti, January 22, 1924. Standard lengths 308, 327, 320 and 309 mm. respectively.

2. Two taken in a bait catch near Los Angeles Harbor by the boat "President" February 9, 1937. Standard lengths 213 and 236 mm. respectively.

3. One taken in a bait haul near Los Angeles Harbor by the boat "Pisa" August 21, 1937. Standard length 233 mm.

4. One taken on hook and line from the Ocean Park pier, Santa Monica Bay November 30, 1937. Standard length 282 mm.

5. One found in the San Pedro fish markets, reported taken locally July 30, 1938. Standard length 215 mm.

6. One found in the San Pedro fish markets, reported taken locally January 18, 1939. Standard length 208 mm.

7. One taken in Newport Bay, March 31, 1939. Standard length 300 mm.

8. One taken on hook and line in upper Newport Harbor, April 7, 1939.

9. One taken at Redondo Beach, May 10, 1939. Standard length 292 mm.

10. One taken ten miles south of Pt. Mugu, August 24, 1940. Standard length 302 mm.

The crania and vertebrae of the specimens recorded under 5, 6, 7, 9 and 10 above have been preserved at the California State Fisheries Laboratory by Charles R. Clothier.

¹ Submitted for publication September, 1949.



FIGURE 1. Adult bonefish *Albula vulpes*. Standard length 234 millimeters. Photo by Al Johns for Vernon M. Haden, San Pedro.

In waters where they are abundant small bonefish usually form schools, and can be located on a tidal flat by the trail of muddy water left in their wake as they grub in the bottom with their projecting conic snouts for molluscs and crustaceans. The roundish teeth which cover the roof of the mouth, its floor and the tongue, are particularly well adapted for crushing these organisms. They select the incoming tide to commence feeding and then work in water from a few inches to possibly a foot in depth. Many times the water is so shallow that their tails extend above the surface as they bury their noses in the soft mud. Large fish have the same general feeding habits but tend to be solitary in their movements or at most travel in groups of but a few individuals. Adult bonefish are known to attain a weight of 14 or 15 pounds though the average is well below this. They are easily confused with fish of the genus *Dixonina* (Myers 1936; and Beebe 1942) but the adults can be readily differentiated by the last dorsal and anal ray. In *Dixonina* this last ray is produced more than twice the length of the preceding ray while in *Albula* there is no elongation of the last ray.

With the bonefish as with certain other soft rayed fishes and eels the young develop in a peculiar manner. They start life as a translucent, band-like organism (Figure 2a) which in no way resembles the adult (Figure 1) and which is known as a leptocephalus. Dr. C. H. Gilbert identified *Albula vulpes* larvae in 1889 but never published his findings. A series of figures by Jordan (1905) and Gill (1907) were prepared from Dr. Gilbert's material.

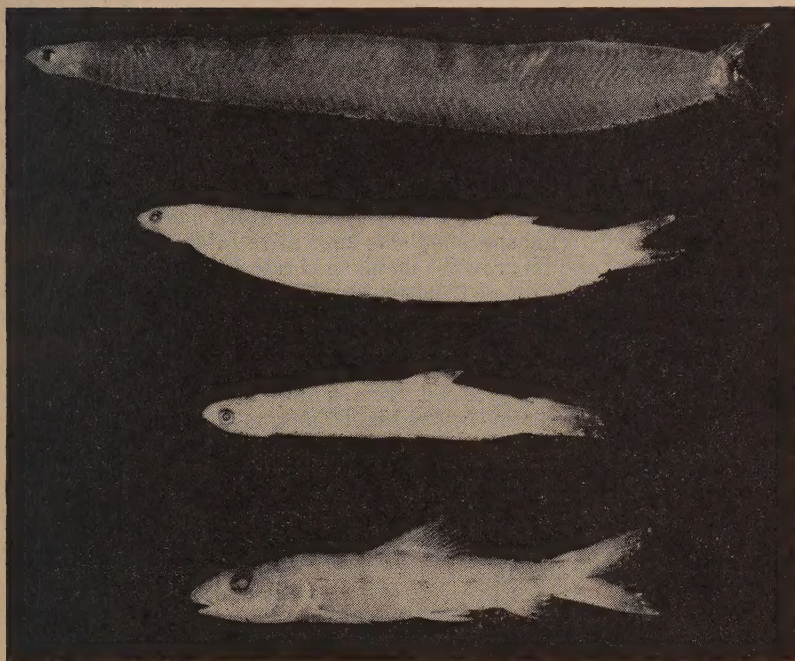


FIGURE 2. Metamorphosis of *Albula vulpes*. Top to bottom (a through d) shows progressively older specimens. Standard length in millimeters, 65; 45; 32; 36. Photo by Al Johns for Vernon M. Haden, San Pedro.

Figure 2 illustrates the metamorphosis of the larvae of *Albula vulpes*. These specimens were taken in a fine meshed seine at San Felipe Bay, Lower California in April, 1949. The top specimen, long, band-like and translucent is the youngest. The next youngest specimen has become slightly opaque, shows a few pigment spots along the dorsal and ventral contours and has shrunk in size. Also the dorsal and anal fins have moved anteriorly along the body. The smallest of the metamorphosing leptocephali shows much more pigmentation and the dorsal and anal fins are found even farther along the body. Finally, the young fish after metamorphosis shows the dorsal fin now in front of the ventrals, while the anal fin is more anterior than in the last leptocephalus. This young fish resembles the adult but has a larger mouth, a more rounded anterior profile and much pigmentation. In Figure 2 the total shrinkage from the youngest larvae to the young fish stage is approximately one and one-eighths inches (29 mm.). In the same period of time the dorsal fin moved forward along the body 31 or 32 myotomes, the anal fin progressed anteriorly 14 or 15 myotomes, and the ventrals remained rather constant.

The following table is presented to demonstrate the relationship of the various fins to the myotomes for the four stages pictured in Figure 2.

	a	b	c	d
Myotome number at dorsal insertion-----	54	49	41	22 or 23
Myotome number at anal insertion-----	69	65	59	54 or 55
Myotome number at ventral insertion-----	35	33	34	34 or 35

Delsman (1926) examined a number of leptocephali of *Albula* from the Gulf of California, as well as *Elops*, and *Megalops* from the Java Sea and gives some excellent line drawings of these. The relationship between fin and myotome of the *Albula* larvae which he examined compares nicely to the relationship of the present larvae of corresponding sizes. Whitley (1937) gives the synonymy of *Albula* and illustrates a leptocephalus of *Albula vulpes* which was collected at New Hebrides. The relationship between fin and myotome of his specimen also agrees quite well with Delsman, and those listed in the present paper.

Hollister (1936) collected a leptocephalus which had been attracted to a light at night. This specimen was kept alive in an aquarium for a period of 10 days and its growth (shrinkage) rate carefully watched and recorded. When first dipped from under the light the specimen was 55 mm. long. It decreased more than $\frac{1}{2}$ inch (15 mm.) during the first 48 hours of capture, then about $\frac{1}{4}$ inch (6 mm.) during the next 48 hours. During the next four days it decreased only one millimeter. In the 10 days during which it progressed from leptocephalus to a young fish form, it shrank in size from the original 55 mm. to about 20 mm.

With the exception of the fin rays the very early leptocephali do not stain when processed with alizarin; however, as metamorphosis progresses, calcification of the skeleton gradually takes place. The first young fish stage possesses a completely ossified skeleton and the various vertebral structures and counts at this stage agree with corresponding structures and counts of adult bonefish.

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PACIFIC SHARPNOSE SHARK (*SCOLIODON LONGURIO*) IN CALIFORNIA AND BAJA CALIFORNIA¹

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The Pacific sharpnose shark, *Scyliodon longurio* (Jordan and Gilbert), a small species of the family Carcharhinidae, has hitherto been recorded only from the tropical waters of the eastern Pacific, from Panama north to the Gulf of California and to Bahía San Lucas at the tip of Baja California (Beebe and Tee-Van, 1941, pp. 112-113; Fowler, 1944, pp. 184, 204, 379, 477). Recently collected specimens extend the range along the outer coast of Baja California to San Diego County, California. From south to north the new record stations are:

(1) Bahía Santa María, Baja California, at about 24° 45' N. Lat., 112° 10' W. Long.: 1 young male, 347 mm. long (extreme total length), collected in a bait net haul by E. W. Kates and Philip Sandoz of the tuna clipper "Renown" on September 3, 1948.

(2) Bahía San Juanico, Baja California, at about 26° 14' N. Lat., 112° 27' W. Long.: 3 young specimens, 343 to 381 mm. long, caught by hook and line in 6 fathoms of water by J. L. McHugh and party on the Scripps Institution of Oceanography research ship "Paolina T," on September 26, 1948.

(3) Bahía Ballenas, Baja California, at about 26° 42' N. Lat., 113° 32' W. Long.: 1 half-grown male, 556 mm. long, dip netted by J. L. McHugh on the "Paolina T" on October 1, 1948. It was captured under a light at the surface, where the depth was about 12 fathoms.

(4) San Diego County, California, off Mussel Rock, Torrey Pines Park, at about 32° 54' N. Lat., 117° 16' W. Long.: 3 embryos, 309 to 327 mm. long, removed from a female "about 2½ feet long." The adult was caught by hook and line at a depth of 90 feet by Boley Ramsower and Dick Hiner on August 15, 1948.

The capture of all these specimens in a six-weeks period is probably a coincidence, rather than an indication of a northward dispersal, for the outer coast of Baja California has been shamefully neglected by fish collectors. Surface temperatures in 1948 (Hubbs, 1949a, pp. 468-479), as indicated by the records at the Scripps Institution Pier, were presumably not high enough to induce a northward spread.

All these specimens correspond satisfactorily with the most recent and most critical characterization of the genus (Bigelow and Schroeder, 1948, pp. 263-265, 292-293). Their general characters are those of the family Carcharhinidae. Their generic identification is based on the following features: the base of the anal fin is less than twice as long as the base of the second dorsal fin; the spiracle is obsolete; the midpoint of the base of the first dorsal is nearer to the axil of the pectoral fin than to the pelvic insertion; the base of the second dorsal fin is about one-third

¹ Contributions from the Scripps Institution of Oceanography, New Series, No. 444. Submitted for publication, September, 1949.

that of the first dorsal; the longest gill-slit is only about one-fourth as long as the first dorsal base; the teeth are alike in the two jaws; all the cusps are smooth-edged and not swollen at the base and all, except those at the symphysis, are broad-based and oblique, with a notch in the outer edge; the caudal peduncle is smooth-sided and has a prominent subtriangular pit above and below; the anterior margin of the nostril bears a small lobe. The prominent labial furrows near the corner of the mouth will serve to distinguish the species at a glance from any of the other eastern Pacific groundsharks (Carcharhinidae).

The specific key characters, as given below, do not conform in all respects with those assigned to *S. longurio* by Bigelow and Schroeder (1948, pp. 293-294) and do not fully confirm their distinction of this eastern Pacific species from those of the Atlantic Ocean and the Indo-Pacific area. The origin of the second dorsal fin lies over the posterior part, but definitely in advance of the end, of the anal base; the origin of the first dorsal fin lies directly over the inner tip of the pectoral; the interspace between the tip of the second dorsal and the upper precaudal pit is 1.4 times the horizontal diameter of the eye in the half-grown, 1.3 to 1.6 times in the young and 0.9 to 1.2 times in the advanced embryos; the upper labial furrow in the half-grown specimen is one-sixth longer than the horizontal diameter of the eye, in the young it is only about as long as, and in the advanced embryos about one-fifth shorter than the eye, which, as usual, decreases in relative size with age.

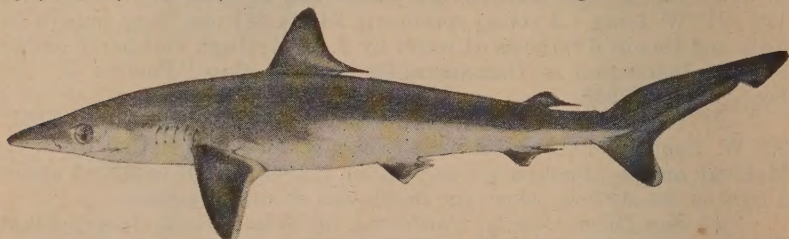


FIGURE 3. *Scoliodon longurio*, half-grown male, drawn by Mrs. Alma Froderstrom from a specimen 556 mm. in total length collected in Bahía Ballenas, Baja California.

Whether *Scoliodon longurio* is distinct from the Atlantic species is not certain from the evidence at hand, though it would appear from the accounts by Garman (1913, pp. 109-117), by Meek and Hildebrand (1923, pp. 51-56, pl. 2) and by Bigelow and Schroeder, and from the measurements of our half-grown specimen, that the upper labial fold is longer in the Pacific specimens than in those from the Atlantic. This is the only distinction used in the key by Bigelow and Schroeder. Our specimens do not confirm the supposed differences emphasized by Meek and Hildebrand in the length of the upper caudal lobe, which is about one-fourth the total length, as also in Atlantic specimens as described by Bigelow and Schroeder; or in the relative dimensions of the interorbital and snout, which in our specimens as in those from the Atlantic are subequal. Nor do we confirm the distinctions given by Jordan and Evermann (1896, p. 42), for the upper teeth are not serrulate, nor less oblique than the lowers.

Our specimens have much longer and sharper snouts than do typical examples of the North Atlantic *Scoliodon terraenovae* (Richardson),

but Bigelow and Schroeder unite with *S. terrae-novae* a tropical Atlantic form, *S. lalandii* (Müller and Henle), which has a snout equally as long and as pointed as that of *S. longurio*. They state that the proportions in the two types of the Atlantic intergrade, but, as one of us has pointed out (Hubbs, 1949b, p. 156), there is a gap between the extreme measurements recorded, and it is probable that two species exist in the Atlantic. The fact that a long sharp snout characterizes all known Pacific specimens, including the northern ones here recorded, further suggests that the two types of the Atlantic are distinct species. If so, the problem remains as to whether *S. longurio* is separable from *S. lalandii*, the long-snouted Atlantic form.

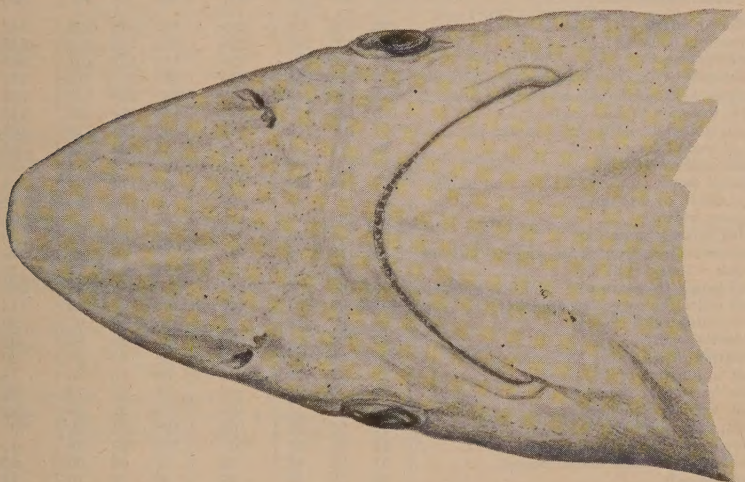


FIGURE 4. *Scoliodon longurio*, lower surface of head of specimen shown in Fig. 3. Drawn by Mrs. Alma Froderstrom.

Doubts also remain as to the separation of *S. longurio* of the eastern Pacific from the several nominal species of the Indo-Pacific region. In fact our specimens conform best with the Indo-Pacific *S. intermedius* Garman, as that species is characterized in the key presented by Bigelow and Schroeder. They also run to *S. intermedius* in Fowler's key (1941, p. 132) to the Indo-Pacific species. According to Garman's key, however, *S. intermedius* has a rounded snout. Even if these two forms should prove identical, the identification of our species as *S. longurio* would still hold, by reason of priority. Fowler (1941, pp. 136-137) suggested that *S. intermedius* is probably not distinct from *S. walbeehmii*. A critical study of the whole genus is very much in order. For use in such a study, proportional measurements of our specimens are given in Table 1.

TABLE 1

Measurements of *Scoliodon longurio* Expressed in Thousandths of the Total Length

Measurements were made by dividers from point to point (not as projections), with parts in normal position. Fins are measured from extreme front.

	Embryos			Young				Half-grown
	San Diego County			Bahia Sta. Maria	Bahia San Juanico		Bahia Ballenas	
Sex	♂	♂	♀	♂	♀	♂	♂	♂
Total length, mm.-----	310	325	327	347	343	354	381	556
Predorsal length-----	320	320	326	329	340	326	325	342
Prepectoral length-----	233	228	243	256	245	249	247	243
Prepelvic length-----	461	458	471	458	472	457	457	468
Distance between dorsal origins-----	328	323	324	319	318	316	318	333
Distance between insertions of paired fins-----	237	237	242	222	232	223	217	239
Pelvic insertion to anal origin-----	148	145	147	135	134	134	134	146
Origin second dorsal to upper caudal pit-----	101	100	103	112	99	112	110	101
Tip of second dorsal to pit-----	26	25	31	40	34	33	33	31
Origin anal to lower pit-----	116	120	122	130	128	128	134	126
Greatest depth-----	113	114	111	130	105	114	106	128
Least depth (before pits)-----	41	41	42	38	34	34	34	38
Greatest width-----	92	92	96	110	87	86	73	92
Width opposite upper pit-----	32	31	31	32	22	26	24	29
Distance between front of first and fifth gill-slits-----	36	38	43	43	42	40	49	49
Length of longest gill-slit-----	22	24	24	30	22	23	24	25
Head length (to nearest point of first gill-slit)-----	205	196	205	212	222	218	211	201
Head width (between first gill-slits)-----	101	95	98	118	109	107	110	113
Interorbital width (fleshy)-----	94	92	98	97	100	96	97	90
Suborbital width-----	94	90	93	98	95	93	89	88
Orbit to nostril-----	29	28	28	30	32	31	30	29
Orbit to junction of lip furrows-----	38	37	39	46	38	40	36	38
Orbit, horizontal diameter-----	28	27	28	26	27	26	24	22
Orbit, vertical diameter-----	30	28	31	29	28	27	26	22
Snout, preocular length-----	94	95	95	103	108	104	100	101
Snout, preoral length-----	91	92	92	101	103	99	98	94
Tip of snout to outer end of nostril-----	61	63	64	69	72	68	66	65
Nostril length-----	19	18	20	20	20	19	19	18
Internarial width (least)-----	50	51	52	52	55	53	51	49
Internarial width (greatest)-----	73	71	76	73	79	75	73	68
Nostril to mouth-----	35	37	34	38	38	39	37	33
Width of mouth (between ends of gape)-----	67	68	70	80	72	72	72	76
Front of mouth to line joining ends of gape-----	48	46	48	40	50	46	48	47
Upper labial furrow-----	22	22	24	27	23	25	24	25
Lower labial furrow-----	16	15	18	14	18	17	17	17
First dorsal fin								
Base-----	93	90	89	95	93	94	104	99
Origin to upper tip-----	114	110	109	101	109	113	123	104
Lower posterior edge-----	39	40	39	37	35	37	33	37
Second dorsal fin								
Base-----	26	28	29	28	29	28	34	31
Origin to upper tip-----	33	36	35	32	---	37	39	34
Lower posterior edge-----	47	46	42	43	41	44	45	42
Anal fin								
Base-----	45	45	43	49	42	47	55	47
Origin to lower tip-----	44	42	46	46	43	51	50	49
Upper posterior edge-----	40	42	43	38	38	37	37	37
Caudal fin								
Upper pit to tip upper lobe-----	258	266	257	264	253	264	259	259
Lower pit to tip lower lobe-----	102	98	95	98	92	103	102	106
Upper pit to apex of notch in upper lobe-----	187	197	186	188	184	190	181	186
Upper pit to nearest point of posterior margin-----	94	93	88	89	87	89	85	85
Lower anterior edge of terminal lobe-----	34	36	37	37	32	39	36	34
Pectoral fin (depressed downward)								
Base-----	52	50	55	54	52	57	53	50
Origin to lower tip-----	117	116	118	118	114	117	122	130
Upper posterior edge-----	49	46	46	46	41	40	45	47
Pelvic fin								
Base-----	45	42	41	43	45	46	47	46
Origin to lower tip-----	50	46	44	48	50	50	50	50
Upper posterior edge-----	25	26	28	29	26	26	27	27

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CONTROL OF GAPEWORM INFECTION IN GAME FARM BIRDS¹

By CARLTON M. HERMAN and RICHARD KRAMER
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INTRODUCTION

The Los Serranos State Game Farm was established in 1927. At first the native valley and gambel quail were the chief birds raised on the farm. In the early 1930's chukar partridges were introduced. A few pheasants were raised almost from the farm's beginning, and a variety of exotic species of pheasants have also been on the game farm during most of its existence. At first bantam and other breeds of chickens were used as brooding hens. Since 1932 the eggs have been hatched entirely in mechanical incubators.

Between 1941 and 1944 sporadic cases of gapeworm (*Syngamus trachea*) occurred in the birds. By this time the concentration of effort was on raising pheasants, chiefly Mongolian and Chinese. The gapeworm infection appeared chiefly in pheasants, although chukar partridges and various exotic species were also involved.

In 1945, gapeworm seemed to be developing into a major problem and the number of cases increased greatly in the succeeding years.

Gapeworm infection has not been reported from either wild or domesticated birds in California except in captive upland game birds at game farms or in holding pens. In past years undoubtedly many birds infected with gapeworms were released in many areas in California, but no subsequent cases of gapeworm have been observed in wild birds or domestic poultry. The practice of releasing game farm birds infected with this parasite has been discontinued.

In general the infection in game farm birds reaches its highest peak during March and April except in holding pens where a practice of keeping the soil continuously moist tends to increase the infection at any season of the year. For the most part birds on wire or dry ground tend to lose the infection, and carriers are few.

An extensive series of tests were made on the effect of leaving pens idle for periods of one or two years. This procedure had no apparent effect on the occurrence of gapeworms when these pens were again inhabited with birds. This seemed to indicate that carry-over in soil was more of a major factor than latent or carrier birds.

Early attempts at control followed the recommendations of the United States Department of Agriculture (Herman, 1945) using barium antimony tartrate as an inhalant. Many of the pheasants were found to be unable to tolerate the dosage required to kill the worms. A method of attack was sought which would require a minimum of disturbance of the birds, be simple of application and economically practical. Encouraging success in the control of animal parasitic nematodes has been reported by soil treatment with methyl bromide by Swanson and Taylor (1943) and Andrews, Taylor and Swanson (1943). However, it was felt that

¹ Submitted for publication September, 1949.

the use of this poisonous gas was too involved for application at the game farms where the infection was prevalent and that some other method of soil control might be found to yield satisfactory results.

Christie (1945) and Chitwood and Buhrer (1945) reported success in combatting nematode parasites of plants by the application of Dowfume and DD to soil. The application of these products seemed more readily to fit the needs at our game farms and it was decided to test these products.¹

All of the experiments reported in this paper were performed at the Los Serranos State Game Farm in Chino, San Bernardino County, California. The pens are 24 x 24 feet, seven feet high wire enclosed with wood baseboard partitions two feet high. They are built in units of 10, consisting of double rows of five pens each, opening on dividing alleys six feet wide. A watering device, consisting of a cement crock, is in the center of each pen. The soil which makes up the bottoms of the pens is heavy and drainage is poor.

PROCEDURE AND RESULTS

In 1947 several experiments were undertaken. All test birds were breeders from a group of one- or two-year old pheasants with no previous history of gapeworm.

Control Experiment

Sixteen pens were used as controls. Nine of the control pens had gapeworm infected birds in 1947, while the other pens had a history of gapeworm in previous years. The control pens were kept idle (free of birds) from the last week in October, 1947 to February, 1948 when seven breeding pheasants (one cock, six hens) were placed in the control pens similar to the procedure for the experimental pens. In March and April six pens contained birds infected with gapeworms.

Experiment No. 1

Five pens, comprising an end unit by themselves, completely surrounded by alleys, were treated mechanically. The water crock was placed atop a pile of rocks each approximately four to six inches in diameter. This bed of rocks was approximately four feet in diameter and two feet deep. The purpose of the experiment was to test the value of eliminating the wet area around the drinking crocks. All these pens had birds with gapeworm infection in 1947. The rocks were arranged in the pens on October 14, 1947 and the seven breeding pheasants were placed in the pens in February, 1948. During March and April, 1948, all pens had gapeworm infected birds.

Experiment No. 2

A unit of 10 pens was used for this experiment. Three of these pens showed gapeworm in 1947 and several others had evidence of gapeworms in previous years. During the last week of October, 1947, these pens were sprayed with 10 percent formalin sufficient to completely wet the surface soil. In February, 1948, seven breeding pheasants were placed in each pen. During March and April gapeworm infected birds appeared in six pens, including the three that had gapeworm the previous year.

¹ The authors wish to express their thanks to Dow Chemical Corporation and Shell Chemical Corporation for the supply of Dowfume and DD, respectively, used in these experiments.

Experiment No. 3

A unit of 10 pens was used. One of these pens had gapeworm in 1947, one had gapeworm in 1946 and was idle in 1947. All others had a history of gapeworm in previous years. During the last week of October, 1947, this pen was sprayed with a mixture of Shell D-D (1, 3- dichloropropylene and 1, 2- dicloropropane) in water sufficient to wet the surface soil thoroughly. One-fifth of a gallon of D-D was applied per pen. In February, 1948, seven breeding pheasants were placed in each pen. In March and April seven of the ten pens contained birds which were infected with gapeworm, including the pen infected in 1946 but not the one which had gapeworm in 1947.

Experiment No. 4

A unit of 10 pens was used. One pen had gapeworm in 1947, four had gapeworm in 1946 and were idle in 1947, and the others had infected birds in previous years. In October, 1947, the soil of these pens was injected with a total of three-eighths of a gallon of D-D per pen. Injections were at one-foot intervals by means of a soil fumigation spot-injection tool (see Fig. 5). This tool was loaned for the purpose by the Greening-Smith Company of Norwalk, California, a local distributor of



FIGURE 5. Soil fumigation spot-injection tool showing method of application. *Photo by Kramer Adams.*

D-D. Seven breeders were placed in each pen in February, 1948. In April one pen of birds became infected with gapeworm. This pen was directly across the alley from a formalin treated pen which had already been heavily infected for several weeks and, in spite of the precautions taken, it was felt by the authors that this infection was carried by an attendant while caring for the birds.

Experiment No. 5

A unit of 10 pens was used. Four were infected with gapeworm in 1947, one had gapeworm in 1946 and was idle in 1947, various others were infected in previous years. The soil of these pens was treated in October, 1947, by injection as in experiment number 4 above, using three-eighths of a gallon of Dowfume W-40 (42 percent by weight of ethylene dibromide in a petroleum extender). Seven breeder pheasants were introduced into each pen in February, 1948. In April three of the pens had gapeworm infected birds. Here again these pens were directly across an alley from pens which had had heavily infected birds for several weeks and it was felt that the infection was carried across by the attendant.

After the above experiments it was decided to repeat the injection procedures with Shell D-D and Dowfume W-40. These experiments were more carefully planned and supervised to keep at a minimum any possibility of contamination by attendants caring for the birds. A group of pens in a different area of the game farm than those used in the above experiments and as controls was chosen.

Experiment No. 6

A unit of 10 pens was used. Birds in three of these pens had gapeworm in 1948 and the same three had gapeworm in 1947; others had gapeworm in previous years. Each of these pens was treated by injection of three-eighths gallon D-D as in experiment No. 4 during the first week of September, 1948. Eight breeder pheasants (one cock, seven hens) were placed in each pen during the last week of February, 1949. No gapeworm appeared in any of the birds up to the conclusion of the experiment when the birds were released in mid-July.

Experiment No. 7

A unit of 10 pens was used. All 10 pens had birds with gapeworm in 1948, some also had a previous history of gapeworm infection. During the last week in August, 1948, each of these pens was treated with Dowfume W-40 as in experiment No. 5. During the last week in February, 1949, eight breeder pheasants were placed in each pen. No gapeworm appeared in any of the birds up to the conclusion of the experiment in mid-July when the birds were released.

DISCUSSION

The experimental pens utilized in 1948 were not used for breeder birds in 1949 and are currently being stocked with young birds. No further data on outbreaks of gapeworm infection in these pens has presented itself.

Concurrently with experiments 6 and 7, five pens were similarly treated with D-D, and four with W-40. These were isolated pens which had a heavy incidence of gapeworm the previous year. All of these pens also remained free of gapeworm following the treatment.

During 1949, when the last reported experiments were performed, birds in a number of pens on the game farm exhibited gapeworm infections and the incidence seemed to be even greater than in previous years.

It should be pointed out that neither the D-D nor the W-40 had any noticeable effect on the plant cover existing in the pens or the growth of cover subsequently planted. Alfalfa was the chief cover plant.

The authors feel that the use of D-D or W-40 is a valuable adjunct to the control of gapeworm in captive upland game birds. It is planned to treat all pens in the state-operated game farm units in California where any recent history of gapeworm is present, by injection of either D-D or W-40. It will be necessary to keep a strict vigilance for carrier birds and remove them from the pens as soon as any suspicious symptoms appear. While it may be necessary to repeat the soil fumigation, it is currently felt that this program will ultimately eradicate the infection.

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PAPILLOMA, SKIN TUMORS IN DEER ¹

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Deer are subject to a great variety of diseases, as are other animals and man. Some of these are easily recognized by anyone observing the animals and can often be diagnosed without further laboratory procedures. An example of such a disease in deer is known as papilloma.

Papilloma, a wart-like overgrowth of the skin, is a tumor caused by a filterable virus. It is non-malignant and entirely confined to the skin. Although it is widely distributed in deer in California it does not occur frequently in any particular area. The warts are most usually seen about the head, neck and shoulders (Fig. 6) but may occur anywhere on the body. They vary in size from minute warts to eight to ten inches in diameter. The larger warts often have an irregular surface reminding one of a cauliflower. Sometimes only a few of the warts are present on an infected animal but more frequently numerous papillomas are present as in the animal illustrated.

This infection does not affect the meat of the animal. Occasionally, when the warts are large and pendulous, they may sap the strength or stunt the growth of the deer. When heavy infections occur the tumors may grow on eyelids forcing the eyes to remain closed and thus cause virtual blindness. This causes the animal considerable difficulty in obtaining food and may result in a weakened or malnourished deer. It also decreases the animal's maneuverability and probably makes it easier prey to predatory species.

Papillomas occur in many species of animals. In man and most animals warts occur principally in the young, and adults are seldom affected. The occurrence of the infection in legal bucks would tend to the conclusion that apparently this is not the case in deer.

Cattle are frequently infected with the same or a similar papilloma. They are found on many parts of the body, but their location depends somewhat on the age of the animal. In the deer, which have come to our attention, there is no evidence of differences in age susceptibility, or in localization on any area of the body of the different age groups. Both sexes have been observed with the infection. In cows, warts usually occur on the udder or teats, whereas in calves under one year of age they are seen most frequently on various parts of the head and on the neck and shoulders. The chief damage in cattle is the loss of leather in tanned hides where the papillomas occurred.

The warts in cattle have been shown by experiments to be infectious. By experimental skin inoculations with wart material these growths can be produced with a fair degree of regularity in healthy cattle under one year of age. Under ordinary circumstances, infection is thought to take place through injuries to the skin when the injured part comes in contact with warty animals, shrubbery, or any object which an affected animal has touched. Epidemics of this infection have been noted in cattle but not in deer.

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Papillomas seem to be most frequent in man, cattle, dogs and rabbits and all these tumors contain filterable agents with which the tumors may be transmitted to other individuals. Forty years ago one investigator claimed to have transmitted warts of cattle to man. This is the only report which would indicate successful transfer from one species of animal to another. The current consensus is that these warts are specific to the host in which they occur and therefore man would not be susceptible to the infection from deer.



FIGURE 6. Deer with extensive papilloma on head and neck. *Photo by C. M. Herman.*

FOOD HABITS OF THE PRONG-HORN ANTELOPE OF CALIFORNIA¹

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Very little has been written concerning the food habits of the prong-horn antelope, *Antilocapra americana* (Ord). The degree of competition of antelope and livestock for range forage has been a source of controversy between the ranchers and the workers interested in increasing the numbers of this big game species. The common assumption that the food preferences of the antelope are the same as that of sheep and cattle has had little factual basis. As early as 1877, Caton noted that the prong-horn was a "dainty" eater, feeding strictly on herbaceous plants and avoiding arboreous food. Einersen (1948), showed the food contents of antelope stomachs from Colorado, Idaho, South Dakota, Oregon, and Nevada to follow the general pattern of browse plants as the sustaining food items, secondly forbs (weeds) and finally grasses. Buechner (1947), from field observations of the feeding habits of antelope in Western Texas, stated that the prong-horn diet in the order of importance consisted of forbs, browse and grasses. Forbs and browse made up 85 percent of the summer diet and 93 percent of the autumn. Couey (1947) presented the results of analyses of 24 antelope stomachs collected from Southeastern Montana in September and October of 1944 and 1945. Eighty-seven and four-tenths percent of the food items were browse, 51.0 percent of which consisted of two varieties of sagebrush (*Artemisia tridentata*) and (*Artemisia cana*); 5.7 percent weeds, and 6.9 percent grass.

ANTELOPE RANGE IN CALIFORNIA

The present range of the prong-horn antelope in California is in the northeastern part of the State. Lassen and Modoc Counties support the largest number of antelope with small numbers being found in Siskiyou, Plumas, Shasta, and Sierra Counties (McLean, 1944). The range occupied today is a small part of the original territory inhabited by the antelope prior to the advent of human settlement in California.

Native vegetation within the range of the antelope is typical of the Great Basin type flora. The dominant plant of the area is common sagebrush (*Artemisia tridentata*); this species is abundant both in the flats and in the more elevated sections. In the lower elevations of the range, two forms of rabbit-brush (*Chrysothamnus nauseosus*) and (*Chrysothamnus viscidiflorus*) occur along with the common sagebrush. In the more elevated hilly regions, it is an association of sierra juniper (*Juniperus occidentalis*), bitterbrush (*Purshia tridentata*), and sagebrush. Curl-leaf mountain mahogany (*Cercocarpus ledifolius*) is the dominant shrub of the brushy covered slopes and ridges. The open range merges into western yellow pine (*Pinus ponderosa*) forest in the higher and better

¹ Submitted for publication October, 1949. Federal Aid in Wildlife Restoration Act, California Project 25R. The authors wish to express their appreciation to various members of the University of California Herbarium for their aid in identification of some of the plants recorded.

watered elevations. Many grasses are found over the antelope range; downy chess (*Bromus tectorum*) is especially abundant. Such forbs as balsam root (*Balsamorhiza* spp.), mules ear (*Wyethia* spp.), and wild buckwheats (*Eriogonum* spp.) are prominent in much of the area along with many other less obvious weedy types.

The chief agricultural activities of the northeast counties are concerned with the grazing of cattle and sheep. Where cultivation is practiced, the growing of crops such as alfalfa and grain for winter feeding of stock are the principal crops. Where natural wet meadows occur they are often fenced in and grazed continuously or are allowed to produce a wild hay for cutting. Small acreages of barley and wheat are grown in the antelope range principally on Madeline Plains in Lassen County and along the South Fork of the Pit River in Modoc County.

COLLECTION OF MATERIAL

The opening of limited hunting seasons for antelope on a permit basis afforded an opportunity for collection of stomach samples for food habits determination. Table 1 gives the seasons, numbers, and locality of the samples collected:

County of collection	TABLE 1 Number of samples taken	
	1942 season *	1949 season †
Lassen -----	17	29
Modoc -----	3	7
Total -----	20	36

* May 29th to June 14th.

† August 26th to September 5th.

METHOD OF ANALYSIS

The stomach samples were collected in formalin preservative, washed in tap water, and placed in a white enamel pan for analysis. Identification and percentage estimates of the food items were made with the aid of a stereoscopic microscope using 9x oculars and 0.7x and 2x objectives.

RESULTS OF THE ANALYSIS

Volume percent and frequency of occurrence of all food items found in the stomach samples from the 1942 and 1949 collections are listed in Table 2. Volume percent by forage class is summarized in Table 3.

TABLE 2

Volume Percent and Frequency of Occurrence in Percent of Food Consumed by California Antelope *

Scientific name	Common name	Volume percent		Frequency of occurrence	
		1942	1949	1942	1949
Lichen		Tr.		5	
Bryophyta	Moss		Tr.		3
Pinus ponderosa	Western Yellow Pine	Tr.		5	
Juniperus occidentalis	Sierra Juniper	0.1	0.1	20	22
Bromus brizaeformis	Rattlesnake Chess (Florets)	Tr.		5	
Bromus tectorum	Downy Chess (Dry seeds, stems, leafage)		Tr.		14
Bromus tectorum	Downy Chess (Green florets, stems, leaf.)	0.1	Tr.	60	8
Bromus sp.	Brome Grass (Florets)	Tr.	Tr.	20	11
Elymus sp.	Wild-rye (Florets)		Tr.		3
Gramineae	Grass family (Dry)	0.5	Tr.	15	28
Gramineae	Grass family (Green)	1.0	1.0	60	14
Eleocharis sp.	Spike-Rush		Tr.		3
Carex sp.	Sedge		Tr.		6
Cyperaceae	Sedge Family	Tr.	Tr.	10	3
Liliaceae	Lily Family (Corms, leafage)	Tr.		5	
Salix sp.	Willow	Tr.		5	
Polygonum aviculare	Wire Grass		4.9		19
Polygonum sp.	Knotweed	0.2	Tr.	5	3
Rumex salicifolius	Willow Dock		0.6		28
Rumex sp.	Dock		Tr.		3
Eriogonum sp.	Wild Buckwheat	0.6	0.2	50	22
Chenopodium murale	Sowbane		2.1		6
Chenopodium sp.	Goosefoot		0.3		14
Grayia spinosa	Hop sage	0.3		10	
Chenopodiaceae	Saltbush Family (Unidentified)		Tr.		6
Amaranthus blitoides	Prostrate Pigweed		0.7		11
Ranunculus sp.	Buttercup	0.2		15	
Sisymbrium altissimum	Tumbling Mustard		5.1		8
Arabis sp.	Rock Cress		Tr.		6
Lepidium montanum	Pepper-grass		0.3		8
Lepidium spp.	Pepper-grass	Tr.	Tr.	15	14
Thlaspi arvense	Penny Cress		Tr.		6
Cruciferae	Mustard Family	Tr.	Tr.	15	6
Rosa sp.	Wild Rose		Tr.		5
Sanguisorba annua	Burnet	0.2		5	
Purshia tridentata	Bitter-brush	13.7	10.4	60	39
Amelanchier alnifolia	Western Service Berry	0.8		10	
Lupinus sp.	Lupine		0.7		6
	Clover	Tr.		5	
Medicago sativa	Alfalfa		1.5		3
Medicago sp.	Medick	Tr.		15	
Astragalus sp.	Rattle-weed	0.2		20	
Vicia sp.	Vetch		0.4		6
Erodium cicutarium	Red-stem Filaree	Tr.	0.6	25	6
Erodium sp.	Filaree	Tr.	0.1	10	11
Viola sp.	Violet		Tr.		3
Epilobium sp.	Willow Herb		0.3		14
Boisduvalia glabella			0.6		6
Oenothera tanacetifolia	Primrose		0.6		39
Oenothera sp.	Primrose	Tr.		5	
Eryngium sp.	Button Snakeroot	0.3	Tr.	10	3
Lomatium sp.	Hog-Fennel	6.2		25	
Carum sp.		4.2		5	
Umbelliferae	Parsley Family (Unidentified)	Tr.		10	
Arctostaphylos sp.	Manzanita	Tr.		10	
Convolvulus arvensis	Bindweed		0.3		3
Phlox sp.	Phlox	5.1	0.6	50	17
Polemoniaceae	Gilia Family		Tr.		3
Phacelia sp.		Tr.	Tr.	5	8
Amsinckia sp.		Tr.	Tr.	5	3
Cryptantha sp.	Nievtas		Tr.		6

TABLE 2—Continued
Volume Percent and Frequency of Occurrence in Percent of Food
Consumed by California Antelope *

Scientific name	Common name	Volume percent		Frequency of occurrence	
		1942	1949	1942	1949
Boraginaceae.....	Borage Family.....		Tr.		3
Collinsia sp.....		Tr.		40	
Pentstemon deustus.....	Pentstemon.....	0.6	0.2	20	8
Pentstemon sp.....	Pentstemon.....		Tr.		3
Valerianaceae.....	Valerian Family.....	Tr.		10	
Lactuca sp.....	Wild Lettuce.....		0.5		14
Taraxacum vulgare.....	Dandelion.....	Tr.		5	
Crepis sp.....			Tr.		3
Haplopappus racemosus.....			1.7		3
Chrysothamnus nauseosus.....	Rabbitbrush.....	3.8	1.2	35	19
Chrysothamnus viscidiflorus.....	Rabbitbrush.....	4.1	Tr.	30	6
Helianthus sp.....	Sunflower.....		2.8		6
Balsamorhiza sp.....	Balsam Root.....	4.5		10	
Wyethia sp.....			0.2		3
Heliantheae.....	Sunflower tribe.....	1.1		5	
Blepharipappus scaber.....			0.3		14
Madia sp.....	Tarweed.....		Tr.		6
Lagophylla ramosissima.....			1.9		14
Iva axillaris.....	Poverty Weed.....	Tr.	17.0	5	56
Eriophyllum lanatum.....		Tr.	2.2	15	17
Eriophyllum sp.....			Tr.		3
Rigipappus leptocladus.....		Tr.		5	
Artemisia tridentata.....	Common sagebrush.....	40.8	35.2	90	89
Arnica sp.....		Tr.		5	
Compositae.....	Sunflower Family (Unidentified).....	Tr.	2.5	40	31
Forbs.....	(Unidentified).....	11.4	1.1	80	50
	Stems (Unidentified).....		1.8		8

* All items are leafage and stems unless otherwise noted.
 1942—20 stomachs analyzed.
 1949—36 stomachs analyzed.

TABLE 3
Volume Percent of Food Items by Forage Type

	Browse	Forbs	Grass	Miscellaneous
1942.....	63.6	34.8	1.6	Trace
1949.....	46.9	50.3	1.0	1.8

Browse species were 63.6 percent of the total food taken in the May-June collections and 46.9 percent of the August-September collections. Common sagebrush (*Artemisia tridentata*) amounted to 40.8 percent of the diet of the late spring antelope and was 35.2 percent of the late summer food taken. In fact, this species seems to be the staple food for antelope in California during the time of year the samples were taken. Sagebrush was found in nearly 90 percent of all the stomachs analyzed. Bitterbrush (*Purshia tridentata*) was 13.7 percent of the May-June diet and 10.4 percent of the August-September food. The only other browse species that amounted to over 1 percent of the antelope diet were

the two rabbit brushes (*Chrysothamnus nauseosus*) and (*Chrysothamnus viscidiflorus*). It is noteworthy that, in the case of the August-September samples, the antelope nipped off quantities of the flower buds of both sagebrush and rabbit brush in addition to taking the stems and leafage.

Forbs, apparently, are high on the list of preferred foods of antelope, making up 34.8 percent of the diet in the May-June samples and 50.3 percent in the August-September group. Forbs were taken in great variety; over 60 species were identified in the 56 stomach samples studied. In addition much unidentified forb type food was present, undoubtedly containing many other species than listed here. Several weedy species that are commonly associated with cultivated lands within the range of antelope were prominent in the diet. Such species were wire grass (*Polygonum aviculare*), sowbane (*Chenopodium murale*), tumbling mustard (*Sisymbrium altissimum*), sunflower (*Helianthus* sp.), poverty weed (*Iva axillaris*) and others. However, willow dock (*Rumex salicifolius*), common in cultivated areas and on the sage flats and dry lake beds, was lightly utilized. See Table 2. Other forbs which occurred as 1 percent or more of the diet in one or both collections were hog-fennel (*Lomatium* sp.), phlox (*Phlox* sp.), balsam root (*Balsamorhiza* sp.), (*Carum* sp.), (*Haplopappus racemosus*), (*Lagophylla ramosissima*) and (*Eriophyllum lanatum*). These last named species are weedy types generally more characteristic of uncultivated lands.

Grass and grass-like plants were little utilized by the antelope even though present in abundance over their range. Only 1.6 percent of the May-June diet was grass and 1.0 percent in the August-September diet. Of the grasses taken downy chess (*Bromus tectorum*) was most important. This species is probably the most common grass occurring on the antelope range.

RELATION TO AGRICULTURE

Alfalfa (*Medicago sativa*) was the only cultivated crop found in the stomachs collected. (See Table 2). It was significant that our analyses revealed no grain eaten despite the fact that antelope were frequently observed in harvested and unharvested grain fields prior to and during the August-September, 1949, hunting season. Many of the antelope were shot in grain fields and adjacent to these fields at Madeline Plains and their stomach analyses revealed the presence of large amounts of poverty-weed and other weedy types abundant in these cultivated fields.

Indirect crop damage can be attributed to trampling and bedding down by the animals. Einersen observed that movements of antelope to and from water when the only available water was located on agricultural developments resulted in crop damage due to trampling. Lassen County farmers have generally expressed little concern over consumption of grain crops by antelope but are more apprehensive of damage incidental to the movements and bedding down of the animals.

It is the opinion of the authors that, perhaps with local exceptions, there is probably no severe competition between livestock and antelope for available range feed. Of the browse species utilized for food by antelope (see Table 2) only bitterbrush is avidly sought by livestock. The most important antelope food, common sagebrush, is unpalatable to cattle and only slightly palatable for sheep.

Competition for forbs on heavily grazed ranges may occur between antelope and sheep. Such species as wild buckwheat, sowbane, hog fennel, balsam root, and sunflowers are relished by livestock, especially sheep. However, many of the weedy plants eaten by antelope, notably (*Lagophylla ramosissima*), *Phlox* sp. (*Arnica* sp.) (*Collinsia* sp.) and many others are considered of little or no value to any class of livestock.

Range grasses, of primary value to cattle and horses were insignificantly utilized by antelope in this study. See Table 3.

SUMMARY

Fifty-six antelope stomach samples were obtained from hunter kills taken in Lassen and Modoc Counties during the seasons of May-June, 1942 and August-September, 1949.

Analysis of this material revealed over 98 percent of the food consumed to be browse and forbs. Common sagebrush was the most important single item taken. Few species of browse plants were utilized but forbs were eaten in great variety. Grass was a minor item in the diet.

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FOURTH PROGRESS REPORT ON THE COOPERATIVE STUDY OF THE INTERSTATE DEER HERD AND ITS RANGE

By INTERSTATE DEER HERD COMMITTEE

INTRODUCTION

A cooperative study of the interstate deer herd and its range was inaugurated in the fall of 1945. Representatives of the Oregon Game Commission, the United States Forest Service, Regions V and VI, and the California Division of Fish and Game are participating in this study. An initial progress report on the preliminary phases of the study (Interstate Deer Herd Committee, 1946), a second progress report (Interstate Deer Herd Committee, 1947) and a third progress report (Interstate Deer Herd Committee, 1949a) have been published, as has the Interstate winter deer range management plan (Interstate Deer Herd Committee, 1949b).

The following report is a compilation of several individual papers presented by the various field workers at the annual meeting of the committee. Personnel of the cooperating agencies which were primarily responsible for the field work reported here are: George L. Burnett and George A. Fischer, Modoc National Forest; William Lightfoot, I. D. Luman, and Robert U. Mace, Oregon Game Commission; Trevenen Wright, Gordon Bolander, and William P. Dasmann, California Division of Fish and Game, and Randal McCain, University of California.

CAR STRIP CENSUS

Two counts of the Interstate and Glass Mountain deer herds were planned for the winter of 1948-49, using the car strip method of census-ing. The first count was planned for December 1948 and the second for January 1949, the December count being for classification purposes and the January count for the purpose of determining numbers.

The December classification count was started December 14th and had to be called off December 15th due to road conditions. Snow depths of from 4 to 11 inches were recorded upon the 18 strips counted. The remaining area was covered either by crusted snow or deep snow which could not be traversed by a conventional pickup or a 4-wheel drive Jeep. Only 297 animals were classified.

Table 1 shows the composition of the herd as indicated by this small sample. Table 2 shows the percentages of bucks by antler classes. Table 3 gives buck-doe and doe-fawn ratios.

TABLE 1
Herd Composition for Past Six Years of Study
Interstate Deer Herd

	1943-44		1944-45		1945-46		1946-47		1947-48		1948-49*	
	Number	Percent of herd	Number	Percent of herd	Number	Percent of herd	Number	Percent of herd	Number	Percent of herd	Number	Percent of herd
Bucks-----	1,548	8.6	1,440	8.0	870	6.4	1,116	9.0	794	8.1	1,264	5.4
Does-----	13,376	63.2	9,900	55.0	8,215	60.4	7,068	57.0	5,782	59.0	11,980	51.2
Fawns-----	5,076	28.2	6,660	37.0	4,515	33.2	4,216	34.0	3,224	32.9	10,156	43.4
Totals-----	18,000	100.0	18,000	100.0	13,600	100.0	12,400	100.0	9,800	100.0	23,400	100.0

* 1948-49 data based on only 297 animals.

TABLE 2
Buck Trend by Antler Point Classes
Interstate Deer Herd

Points	1943-44		1944-45		1945-46		1946-47		1947-48		1948-49*	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
1-----	77	5	130	9	70	8	112	90	151	19.0	316	25.0
2-----	465	30	403	28	226	26	279	25	321	40.5	396	31.3
3-----	465	30	360	25	226	26	245	22	131	16.6	236	18.7
4-----	433	28	489	34	331	38	335	30	146	18.4	158	12.5
4+-----	108	7	58	4	17	2	145	13	43	5.5	158	12.5
Totals-----	1,548	100	1,440	100	870	100	1,116	100	792	100.0	1,264	100.0

* 1948-49 data based on only 18 bucks.

TABLE 3
Buck-doe and Doe-fawn Ratios by Census Years

Season	Number of animals per 100 Does		Number of deer classified
	Bucks	Fawns	
1937-38.....	18	81	1,262
1938-39.....	29	125	2,882
1939-40.....	20	103	1,338
1943-44.....	14	45	5,986
1944-45.....	15	67	3,007
1945-46.....	11	54	1,696
1946-47.....	16	61	1,603
1947-48.....	14	56	1,736
1948-49.....	11	85	297
Glass Mountain Herd			
1944-45.....	26	71	432
1945-46.....	26	65	587
1946-47.....	25	60	437
1947-48.....	16	69	748
1948-49.....	15	87	246

The January count was accomplished by using both Jeeps and a Weasel. The weather was generally clear and cold. In fact, subzero temperatures were encountered each morning of the January count. (-1° to -24° .)

Very few deer were found outside the census area. The few tracks seen led into the winter range.

The number counted was very large indicating a herd of 23,400 animals as against 9,800 for the year before. The Glass Mountain Herd was also much larger—8,100 as against 2,680 of a year ago. (See Table 4). It is felt that the count was as accurate as the counts which have been made in former years. The same methods and strips were used as were used heretofore and experienced men participated in the count.

TABLE 4
Deer Population in the Principal Counting Units, 1947-1948

Blue Mountain—Boles.....	2,400
Badger Pine.....	350
Bitterbrush—Transition.....	8,550
Juniper annual grass.....	12,100
Total Interstate Herd.....	23,400
Glass Mountain Herd.....	8,100

Undoubtedly the long heavy winter concentrated the Interstate Herd so that it was more completely counted than in former years. It is also probable that more of the resident deer using areas outside the winter area congregated and were counted in January.

STATE LINE TRACK COUNT

The 1949 spring migration track count along the California-Oregon state line was conducted between April 20th and May 12th.

Weather conditions were very favorable for counting. The same procedures were followed as in the previous counts. Brush drags were utilized to obliterate counted tracks and prepare a bed for successive observations. When road conditions permitted, a Jeep was used for dragging purposes. Saddle horses served when use of the Jeep was not practical.

One modification in 1949 was the division of the entire strip into two sections, each of which was counted every other day. This provided for more complete coverage and the accuracy of the count was not impaired. Mileposts and other natural landmarks were used to identify counting strips as in previous years.

A recapitulation of the total count is provided in Table 5. The total count for each day was obtained by subtracting the number of southbound

TABLE 5
State Line Track Count by Days—1947-1948-1949

Day	Number of deer migrating north		
	1947	1948	1949
April 10.....	2,152		
11.....	414		
12.....	812		
13.....	511		
14.....	872		
15.....	588	36	
16.....	788	19	
17.....	412	10	
18.....	577	29	
19.....	540	32	
20.....	403	53	
21.....	393	35	2,377
22.....	244	64	
23.....	187	172	1,823
24.....	149	59	
25.....	172	162	1,608
26.....	299	133	
27.....	212	27	
28.....	98	79	2,446
29.....	61	12	
30.....		21	1,168
May 1.....		270	
2.....		188	
3.....		960	1,264
4.....		566	
5.....		369	1,194
6.....		308	
7.....		476	
8.....		476	
9.....		562	865
10.....		392	
11.....		486	680
12.....		830	222
13.....		342	
14.....		368	
15.....		878	
16.....		320	
17.....		78	
22.....		676	
23.....			364
25.....		653	
26.....			
Totals.....	9,884 *942	9,665	14,011
	10,826		

* Tracks counted between M. P. 10 and M. P. 6 on April 22d.

tracks from northbound tracks in order to determine the daily northbound migration. The results of daily counts in the spring of 1947 and 1948 are included for comparison purposes. All deer crossing the line prior to the first day of counting are included in the first day's total.

Table 6 summarizes the comparative migration totals by units for the past three years.

TABLE 6
State Line Track Count by Count Units—1947-1948-1949

Count unit	Number of deer migrating north		
	1947	1948	1949
M.P. 7 to Corral			180
Corral to Adobe Flat		140	1,233
Adobe Flat to Rock Creek	(Est. 1,500)	509	722
Rock Creek to Fort Spring (M.P. 19)		549	710
Fort Spring (M.P. 19) to M.P. 18	528	498	696
M.P. 18 to M.P. 17	1,773	1,570	1,763
M.P. 17 to M.P. 16	1,864	1,166	1,465
M.P. 16 to M.P. 15	881	558	556
M.P. 15 to M.P. 14	984	677	815
M.P. 14 to M.P. 13	849	677	689
M.P. 13 to M.P. 12	1,954	1,142	1,704
M.P. 12 to M.P. 11	122	144	277
M.P. 11 to M.P. 10	929	1,025	1,216
M.P. 10 to Young Valley	942	974	1,985
Totals	10,826	9,665	14,011

TABLE 7
Deer Use in the Pine-bitterbrush Vegetation Type

Unit number	Area acres	1947-1948			1948-1949		
		Average deer days 1 acre	Total deer days	Number of plots	Average deer days 1 acre	Total deer days	Number of plots
Inside Interstate Boundaries							
24	16,380	18.6	304,000	7	29.5	480,000	20
25	9,400	14.3	134,100	3	15.5	145,500	6
26	2,440	*(20.0)	48,500	0	15.5	37,700	2
27	4,380	7.0	30,600	1	9.0	39,400	2
28	28,900	11.7	338,000	12	6.1	175,000	32
Totals	61,500	13.9	855,200	23	14.2	877,600	62
Outside Interstate Boundaries							
29	2,170	6.0	13,020	2	6.0	13,020	3
30	13,460	17.7	239,000	6	15.5	209,000	11
31	31,970	7.6	242,100	18	4.7	149,500	35
Totals	47,600	10.3	494,120	26	7.8	371,520	49
Total for Both Units							
Totals	109,100	12.4 108%	1,349,320	49	11.5 100%	1,249,120	111

* Estimate.

TABLE 8
Deer Use in the Sagebrush Vegetation Type

Unit number	Area acres	1947-1948			1948-1949		
		Average deer days 1 acre	Total deer days	Number of plots	Average deer days 1 acre	Total deer days	Number of plots
Inside Interstate Boundaries							
14-----	2,070	37.0	76,300	2	51.6	106,200	5
15-----	3,930	10.0	39,300	3	80.5	315,000	4
16-----	3,530	*(0.0)	00,000	0	*(0.0)	000,000	0
16A-----	3,500	*(0.0)	00,000	0	*(0.0)	000,000	2
17-----	1,910	2.0	3,820	2	21.0	40,000	4
18-----	8,000	14.7	117,000	6	19.0	151,200	17
19-----	4,120	14.0	57,800	1	14.8	60,800	4
20-----	4,420	12.0	52,800	4	23.9	105,000	10
21-----	2,470	21.3	52,300	3	12.0	29,600	3
22-----	10,920	2.2	24,000	11	2.1	23,000	23
Totals-----	44,870	9.4	423,320	32	18.6	830,800	72
Outside Interstate Boundaries							
23-----	8,980	11.4	102,120	5	37.0	331,000	10
Total for Both Units							
Totals-----	53,850	9.8 45%	525,820	37	21.7 100%	1,161,800	82

* Estimate.

TABLE 9
Deer Use in the Juniper Vegetation Type

Unit number	Area acres	1947-1948			1948-1949		
		Average deer days 1 acre	Total deer days	Number of plots	Average deer days 1 acre	Total deer days	Number of plots
Inside Interstate Boundaries							
1-----	22,200	27.1	600,000	14	60.7	1,340,000	25
2-----	43,100	*(3.0)	129,300	0	*(2.0)	86,200	0
3-----	2,760	3.0	8,280	2	3.2	8,780	6
4-----	10,100	18.4	185,000	6	29.6	299,000	13
5-----	5,410	2.0	10,820	3	30.1	162,500	10
6-----	1,210	6.0	7,260	1	16.0	19,400	4
7-----	7,510	16.6	124,500	5	25.5	191,000	10
8-----	7,820	40.0	313,000	3	16.0	125,000	3
9-----	2,870	35.0	100,000	1	22.5	64,200	4
10-----	22,450	5.2	116,100	9	4.7	105,100	19
11-----	2,090	41.0	85,100	2	18.5	38,600	4
Totals-----	127,520	13.2	1,679,360	46	19.1	2,439,780	98
Outside Interstate Boundaries							
12-----	1,850	19.5	36,000	2	65.0	119,500	2
13-----	3,260	9.0	32,500	1	19.7	63,800	3
Totals-----	5,110	13.4	68,500	3	35.8	183,300	5
Total for Both Units							
Totals-----	132,630	13.2 67%	1,747,860	49	19.7 100%	2,623,080	103

* Estimate.

TABLE 10
Deer Use in the Grassland Vegetation Type

Unit number	Area acres	1947-1948			1948-1949		
		Average deer days 1 acre	Total deer days	Number of plots	Average deer days 1 acre	Total deer days	Number of plots
Inside Interstate Boundaries							
32-----	3,110	10.6	31,400	5	11.1	34,500	11
33-----	10,800	6.5	70,000	11	4.0	43,200	18
34-----	5,780	0.1	578	10	0.5	2,890	11
35-----	17,610	2.7	47,400	22	5.7	100,000	38
36-----	920	*(3.0)	2,760	0	*(3.0)	2,760	0
Totals-----	38,220	4.0	152,138	48	4.8	183,350	78
Outside Interstate Boundaries							
37-----	2,300	*(6.2)	14,100	0	6.2	14,100	6
38-----	1,800	*(38.0)	68,100	0	38.0	68,100	4
Totals-----	4,100	-----	82,200	0	20.1	82,200	10
Total for Both Units							
Totals-----	42,320	5.5 88.5%	234,338	48	6.3 100%	265,550	88
Grand Total for All Types							
Totals-----	337,900	11.4 73%	3,857,338	183	15.6 100%	5,299,550	384

* Estimate.

Graphic representations of the track count by days is provided in Figure 7. Excluding the first day totals, the peak of migration was reached on April 14 in 1947, May 3 in 1948 and April 23 in 1949.

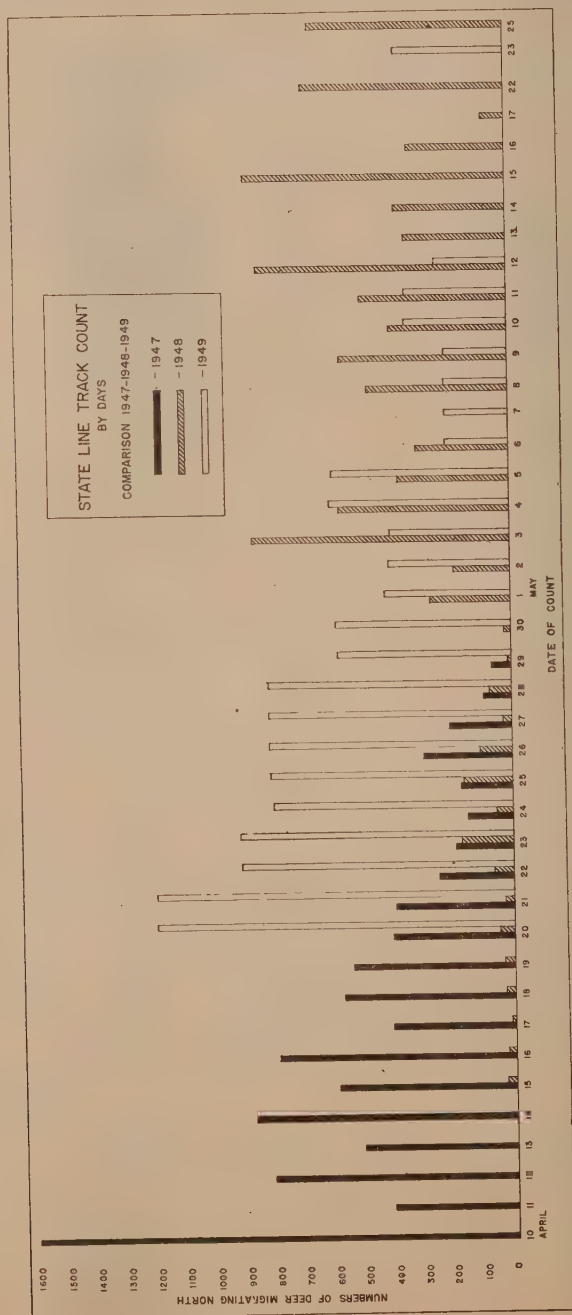


FIGURE 7. Numbers of deer migrating north by days.

Figure 8 graphically compares the migration by count units. Those routes used heaviest during the past three years are between Mileposts 16-18, 12-13, and 6-10.

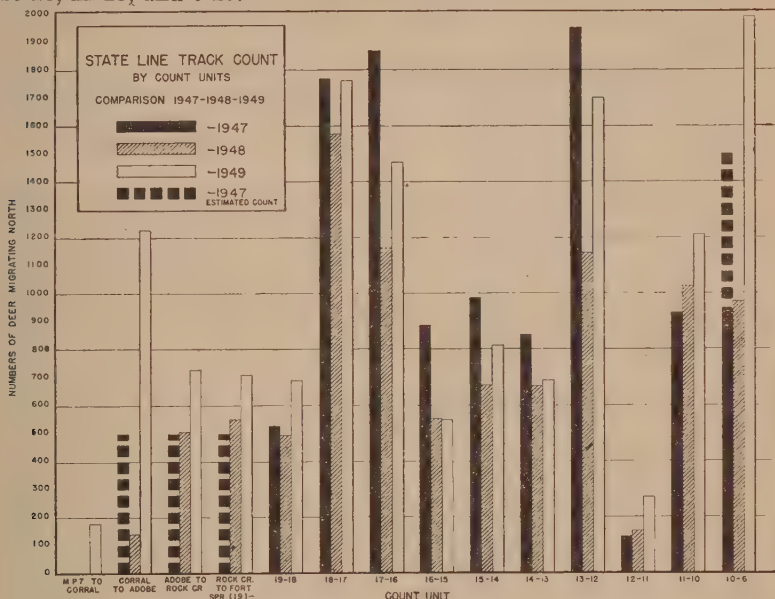


FIGURE 8. Numbers of deer migrating north between track counting intervals.

The tables show that total deer days by types inside and outside of the Interstate range boundaries were as follows:

Number of Deer Days			
Range type	Inside	Outside	Total
Pine-bitterbrush	877,600	371,520	1,249,120
Sagebrush	830,800	331,000	1,161,800
Juniper	2,439,780	183,300	2,623,080
Grassland	183,350	82,200	265,550
Total	4,331,530	968,020	5,299,550

These figures may be compared with the use data obtained in 1948 as shown below:

Total Deer Days		
Range type	1948	1949
Pine-bitterbrush	1,349,320	1,249,120
Sagebrush	525,820	1,161,800
Juniper	1,747,860	2,623,080
Grassland	234,338	265,550
Total	3,857,338	5,299,550

The comparison shows an increase in deer days in all the range vegetation types except the pine-bitterbrush, from which deer were pushed into the lower lying sagebrush and juniper areas by heavy snows. The computed total for the 1948-49 season of 5,299,550 deer days is an increase over the 1947-48 total of 37 percent.

The average length of stay by deer on the winter range for the winter of 1948-49 is estimated at 184 days, October 25th to April 27th.

This is eight days less than the 192-day average for the previous year. When the total of 5,299,550 deer days is divided by 184 days, a total deer population of 28,800 animals is obtained. This is an increase of 44 percent over 20,000, the population computed from the 1947-48 pellet group data.

It is important to distinguish the difference between number of deer and deer days use of the range. The data indicates a 44 percent increase in deer numbers, but only a 37 percent increase in deer days. While more deer were on the range last winter, the length of stay was shorter than during the previous season.

The pellet count data are a measure of forage use. They do not tell where the deer came from or how many are still living. There is no effective means of determining from the pellet count data the exact numbers of animals in any particular herd using this area. Since the crux of management is to keep the range at a level of maximum production, it makes little difference where the deer come from so long as their numbers are kept in balance with the supply of available forage. The number of deer days of use per acre is not a measure of proper range use. The condition and vigor of the forage plants are the factors upon which carrying capacity should be based. When forage density, percentage cropping, and the pellet group data are combined, most of the elements are at hand that are necessary for proper deer range management.

Since the data accumulated since 1945 indicates that the heaviest deer use occurs on a limited portion of the range, the balance of the area being used but lightly, it is thought that in the future the pellet group census may be confined to this key area, where the heaviest use occurs. Using the data presented in this paper as a base, percentage increases or decreases in deer days use on this key area may be applied to the entire winter range if it is desired. It is believed that data gathered from units 1, 4, 5, 6, 7, 8, 9, 11, 12, 14, 15, 23, 24, and 32, which total about 100,000 acres, should make an index upon which to base management. These units comprise the key area, and if this area is properly safeguarded from over-use, the balance of the range should be automatically protected.

FORAGE STUDIES

During 1948, 199 forage sample plots were established on the Interstate winter deer range. There are now a total of 399 forage plots on the winter range.

The line intercept method used to measure ground cover and the techniques used to estimate forage utilization were the same as described in the third progress report (Interstate Deer Herd Committee, 1949a).

Ground Cover Measurements

Herbaceous growth during 1948 was exceptionally good. This greater volume and spread of leafage is reflected in the cover measurements made that year. Another factor that tended to increase the 1948 vegetation measurements was the time the measurements were made. The plots established in 1948 were set out in July at the peak of the growing season; those established in 1947 were measured in October after livestock had consumed part of the forage.

The ground cover composition as indicated by the sample plots is given by types in Table 11. Composition of the vegetation cover will be found in Table 13.

TABLE 11
Analysis of Ground Cover
Interstate Winter Deer Range
 (Based on 396 plots: 198,000 inches of line intercepts)

Ground cover	Pine-bitter- brush type	Sagebrush type	Juniper type	Grassland type
Bare soil.....	17.5	39.4	34.2	26.0
Rock.....	3.3	5.8	11.1	9.0
Litter.....	46.8	13.6	18.5	26.7
Moss.....	0.2	0.1	0.5	0.2
Dead Arctostaphylos.....	0.2			
Dead Artemisia.....	0.3	3.2	2.6	0.4
Dead Cercocarpus.....	0.2		0.1	0.0
Dead Chrysothamnus.....	0.3	0.3	0.3	0.2
Dead Juniperus.....			0.0	0.0
Dead Purshia.....	2.8	0.6	1.0	0.1
Dead Prunus.....	0.0			
Dead Ribes.....	0.0			
Total Nonproductive.....	71.6	63.0	68.3	62.6
Annual grasses.....	1.4	1.7	4.8	12.6
Annual forbs.....	1.5	2.7	4.2	12.0
Total Annuals.....	2.9	4.4	9.0	24.6
Arctostaphylos patula.....	0.2			
Artemisia spp.....	1.1	20.8	10.0	1.8
Amelanchier spp.....		0.0		
Ceanothus prostratus.....	3.2	0.0		0.0
Cercocarpus ledifolius.....	0.3		0.1	
Chrysothamnus spp.....	0.9	1.2	1.4	1.8
Juniperus.....	0.3	0.0	0.8	
Phlox spp.....		0.2	0.2	0.0
Pinus ponderosa.....	0.6			
Prunus spp.....	0.1		0.0	
Purshia tridentata.....	4.1	1.2	1.1	0.0
Ribes spp.....			0.1	
Rosa spp.....			0.0	
Unclassified.....	0.0			
Total Browse Species.....	10.8	23.4	13.7	3.7
Agropyron saxicola.....	0.1			0.0
Agropyron spicatum.....	0.3	0.4	0.6	1.2
Bromus carinatus.....	0.0		0.0	
Carex spp.....	2.3	0.2	1.1	0.2
Danthonia spp.....		0.1	0.1	
Distichlis spp.....			0.0	
Elymus spp.....	0.0	0.1	0.2	0.1
Festuca idahoensis.....	0.8	0.7	1.0	0.2
Juncus spp.....		0.1		
Koeleria cristata.....	0.1	0.1	0.0	0.0
Poa spp.....	1.6	3.7	3.6	4.0
Sitanion hystrix.....	3.2	1.1	0.8	0.5
Stipa spp.....	2.7	0.5	0.9	1.1
Total Perennial Grasses.....	11.1	7.0	8.3	7.3
Achillea spp.....	0.2			
Antennaria spp.....	0.1	0.3	0.1	0.1
Aster spp.....	0.1			0.1
Astragalus spp.....				0.0
Balsamorhiza spp.....	1.4	1.3	0.3	1.0
Eriogonum spp.....		0.0		
Lupinus spp.....		0.2		0.3
Vicia spp.....	0.2			0.1
Wyethia mollis.....	1.3			0.1
Unclassified.....	0.3		0.3	0.1
Total Perennial Forbs.....	3.6	1.9	0.7	1.8
Grand total.....	100.0	100.0	100.0	100.0

TABLE 12
Number of Plots on Which Each Class of Cover Occurs
Interstate Winter Deer Range

Ground cover	Number of plots with cover			
	Pine-bitter-brush type	Sagebrush type	Juniper type	Grassland type
Number of plots in type.....	100	100	98	98
Bare soil.....	99	100	97	98
Rock.....	59	70	75	73
Litter.....	100	99	98	98
Moss.....	10	9	21	7
Dead <i>Arctostaphylos</i>	4			
Dead <i>Artemisia</i>	13	78	69	10
Dead <i>Cercocarpus</i>	3		1	1
Dead <i>Chrysothamnus</i>	12	9	13	10
Dead <i>Juniperus</i>			2	1
Dead <i>Purshia</i>	60	13	24	6
Dead <i>Prunus</i>	1			
Dead <i>Ribes</i>	1			
Annual grasses.....	59	62	83	86
Annual forbs.....	71	94	91	93
<i>Arctostaphylos patula</i>	6			
<i>Artemisia</i> spp.....	20	92	84	21
<i>Amelanchier</i> spp.....		1		
<i>Ceanothus prostratus</i>	39	1		1
<i>Cercocarpus ledifolius</i>	7		1	
<i>Chrysothamnus</i> spp.....	29	24	42	24
<i>Juniperus</i>	12	4	21	
<i>Phlox</i> spp.....		23	15	7
<i>Pinus ponderosa</i>	26			
<i>Prunus</i> spp.....	5		1	
<i>Purshia tridentata</i>	70	17	24	2
<i>Ribes</i> spp.....			3	
<i>Rosa</i> spp.....			1	
Unclassified.....	5			
<i>Agropyron saxicola</i>	4			2
<i>Agropyron spicatum</i>	31	23	23	37
<i>Bromus carinatus</i>	5		2	
<i>Carex</i> spp.....	79	14	14	8
<i>Danthonia</i> spp.....		4	6	
<i>Distichlis</i> spp.....			1	
<i>Elymus</i> spp.....	2	7	12	9
<i>Festuca idahoensis</i>	27	37	45	11
<i>Juncus</i> spp.....		2		
<i>Koeleria cristata</i>	12	8	5	2
<i>Poa</i> spp.....	78	82	90	74
<i>Sitanion hystrix</i>	93	72	64	38
<i>Stipa</i> spp.....	92	31	51	46
<i>Achillea</i> spp.....	27			
<i>Antennaria</i> spp.....	11	21	10	4
<i>Aster</i> spp.....	4			1
<i>Astragalus</i> spp.....				5
<i>Balsamorhiza</i> spp.....	39	17	6	10
<i>Eriogonum</i> spp.....		7		
<i>Lupinus</i> spp.....		8		10
<i>Vicia</i> spp.....	7			2
<i>Wyethia mollis</i>	40			1
Unclassified.....				

TABLE 13
Percentage Vegetation Composition by Range Types
Interstate Winter Deer Range

Plant species	Pine-Bitterbrush	Sagebrush	Juniper	Grassland
Range Types				
Shrubs				
Arctostaphylos patula	0.69			
Amelanchier spp.		0.02		
Artemisia spp.	3.89	56.11	31.59	4.95
Ceanothus prostratus	11.32	0.06		0.00
Cercocarpus ledifolius	0.88		0.16	
Chrysothamnus spp.	3.05	3.18	4.45	4.81
Juniperus occidentalis	1.17	0.11	2.45	
Pinus ponderosa	2.06			
Phlox spp.		0.62	0.57	0.13
Prunus spp.	0.49		0.13	
Purshia tridentata	14.42	3.23	3.60	0.10
Ribes spp.			0.21	
Rosa spp.			0.03	
Others	0.09			
Total Shrubs	38.06	63.33	43.19	9.99
Grasses and Grasslikes				
Annual grasses	4.88	4.65	15.06	33.74
Agropyron spp.	0.41			0.08
Agropyron spicatum	1.14	1.05	1.77	3.31
Bromus carinatus	0.07		0.08	
Carex spp.	8.27	0.67	3.44	0.52
Danthonia spp.		0.24	0.34	
Distichlis spp.			0.03	
Elymus spp.	0.05	0.15	0.55	0.34
Festuca idahoensis	2.64	2.02	3.07	0.50
Juncus spp.		0.14		
Koeleria cristata	0.31	0.15	0.15	0.12
Poa spp.	5.74	10.09	11.33	10.51
Sitanion hystrix	11.19	2.98	2.66	1.37
Stipa spp.	9.49	1.33	2.70	2.90
Total Grasses	44.19	23.47	41.15	53.32
Forbs				
Annual forbs	5.31	7.31	13.36	32.18
Achillea spp.	0.76			
Antennaria spp.	0.42	0.78	0.20	0.15
Aster spp.	0.26			0.13
Balsamorhiza spp.	5.07	3.54	1.15	2.65
Erigonum spp.		0.11		
Lupinus spp.		0.64		0.77
Wyethia spp.	4.50			0.20
Vicia spp.	0.55			0.20
Others	0.88	0.82	0.95	0.41
Total Forbs	17.75	13.20	15.66	36.69
Total Vegetation	100.00	100.00	100.00	100.00

DEER PELLET GROUP COUNT

Pellet group counts on the Interstate winter deer range were initiated in 1945 and expanded each year thereafter. The most intensive counts were made in 1947, but large areas were left unsampled. The 384 one-tenth acre plots counted in the spring of 1949 gives the best coverage to date. The uniformity of data obtained for different types of cover indicates that the 1949 data should be adequate as a base from which to measure trends.

The method used in counting and compilation was the same as in 1948 (See also McCain, 1948). For compilation purposes the range was divided into 38 units, totaling 337,900 acres, as shown in Figure 9. The units are based on general cover types and upon degree of use by deer. They give a picture of the relative importance for deer of different areas of winter range.

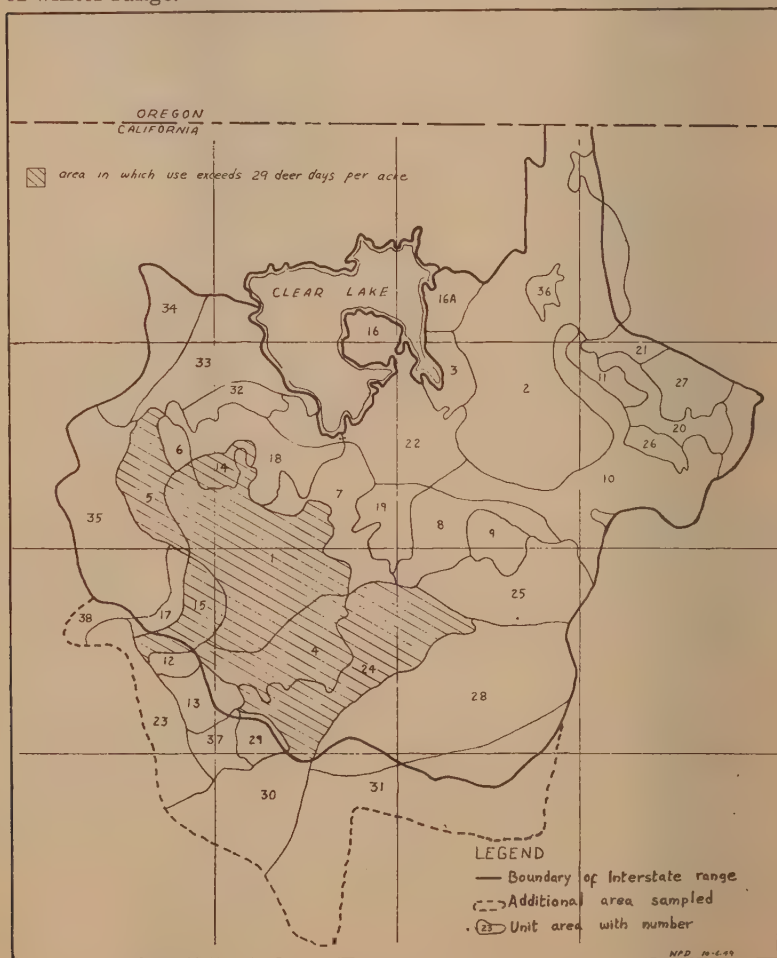


FIGURE 9. Units used in compilation of the pellet group data.

Of the 337,900 acres sampled, 272,000 acres are within the boundaries of the Interstate winter deer range. However, the areas of heavy deer use cut across the Interstate winter range western boundary and indicate that the separation of the area into two herd ranges is purely arbitrary. The summation of use by units by types given in Tables 7, 8, 9, and 10 separates the use within the Interstate deer winter range boundaries from that outside for comparison purposes only. There is no way of determining from the pellet group counts just what fraction of the total use should be assigned to the interstate deer herd alone.

Forage Utilization Check

The Interstate winter deer range management plan (Interstate deer herd committee, 1949b) lists bitterbrush (*Purshia tridentata*) as the key browse species for both livestock and deer wherever it occurs in sufficient abundance to make a base for practical management. Western juniper (*Juniperus occidentalis*) is listed as the key browse species for deer in the mixed sagebrush and juniper range types. Bluegrass (*Poa secunda* and *Poa nevadensis*) is listed as the key herbaceous species for deer in all range types and for livestock in the pine-bitterbrush type. Squirreltail (*Sitanion hystrix*) is listed as the key species for livestock in the grassland type, and Idaho fescue (*Festuca idahoensis*) in the sagebrush and juniper types.

Utilization data listed below are carried to one decimal point to facilitate comparisons and not because it is believed the sampling method yields that degree of accuracy.

Bitterbrush: An examination indicates that bitterbrush occurs in sufficient abundance for practical management in the pine-bitterbrush type and on certain contiguous areas in the juniper and sagebrush types. Data from these limited areas are included with data from the pine-bitterbrush type in order to derive utilization figures for this bitterbrush base area.

It will be seen below that over-all cropping of the leader growth of bitterbrush during the 1948-49 season increased about 9 percent over 1947-48 figures for the bitterbrush base area. Cropping by deer alone increased 33 percent. Livestock cropping decreased 8 percent (see Table 14).

TABLE 14
Average Percentage Cropping of Bitterbrush
Bitterbrush Base Area

1947-1948			1948-1949		
Livestock	Deer	Total	Livestock	Deer	Total
20.1	16.2	36.3	18.4	21.5	39.9

To provide further analysis of what is happening on the range when the current level of use prevails the data was analyzed on a plot basis. It was found that average percentage cropping on 34 percent of the plots fell into the 60 or more percent class during 1948-49. This is shown below in Table 15.

TABLE 15
Intensity of Cropping of Bitterbrush by Plots
Bitterbrush Base Area

Average percent cropping class	1948-1949			
	Fall		Spring	
	Number	Percent	Number	Percent
0-29.9.....	51	62	32	39
30-59.9.....	20	25	22	27
60 plus.....	11	13	28	34
Totals.....	82	100	82	100

This analysis shows the danger inherent in reliance on an over-all average from an extensive range if cropping is not fairly uniform over the range. Where the pattern of use is such that data from heavily used areas are balanced out by data from lightly used areas, an over-all average may hide the fact that the heavily used areas are being depleted. Management should be based on key areas, that is on the areas where cropping is heavy, if they occur on a range. Areas that are used only lightly because of snow, topography, or other factors, should take care of themselves if stocking is not too heavy on adjacent key areas. Cropping data on a proposed Interstate deer management area will be given later in this report.

Juniper: The juniper base area on which this tree is considered the key browse species for deer includes both the juniper and sagebrush range types. Data from plots on the juniper base area indicates that cropping of terminal twigs of juniper trees during the 1948-49 winter season increased 59 percent over that of the previous year (see Table 16).

TABLE 16
Average Percentage Cropping of Juniper Trees
Juniper Base Area

Range type	1947-1948		Average percent cropping	1948-1949		Average percent cropping
	Number trees	Number plots		Number trees	Number plots	
Sagebrush.....	3	2	2.0	8	7	20.0
Juniper.....	35	27	15.0	75	52	22.5
Totals.....	38	29	14.0	83	59	22.2

Intensity of cropping of juniper by plots in the juniper base area is given below. The increased use of juniper browse during the 1948-49 season resulted in an average cropping of 40 percent or more of the twig growth on 13 percent of the plots on which this tree species is present as shown in Table 17.

TABLE 17
Intensity of Juniper Cropping by Plots
Juniper Base Area

Average percent cropping class	1948-1949	
	Number plots	Percent
0-19.9-----	30	51
20-39.9-----	21	36
40 plus-----	8	13
Totals-----	59	100

Bluegrass: Cropping data for bluegrass in the four range types is given below. It will be seen that average use of bluegrass in the pine-bitterbrush range type (in which it is considered the key species for livestock) decreased during 1948 from 21.5 percent to 10.4 percent, but it remains still the grass species most heavily used in that type. In the other range types, total cropping of bluegrass was heavier in 1948 than in 1947. Use of the early spring growth by deer in 1949 was generally lower than it was the year previous, the average percentage cropping for all types falling from 4.5 percent to 3.8 percent, as shown in Table 18.

TABLE 18
Average Percentage Cropping of Bluegrass

Type	1947			1948			1949
	Deer*	Live-stock	Total	Deer	Live-stock	Total	Deer
Pine-bitterbrush-----	4.3	21.5	25.8	4.3	10.4	14.7	2.1
Juniper-----	5.5	6.8	12.3	5.5	9.2	14.7	3.8
Sagebrush-----	2.9	4.8	7.7	2.9	9.6	12.5	3.8
Grassland-----	5.2	0.9	6.1	5.2	4.3	9.5	5.6
All-----	4.5	5.6	10.1	4.5	8.6	13.1	3.8

* 1948 spring data has been used here for lack of data for spring, 1947; total cropping is actual estimate made in fall, 1947.

Table 19, showing intensity of cropping of bluegrass by plots, indicates that use of the early growth of this grass by deer in the spring is generally light. Only 5 percent of the plots show an average cropping of 20 percent or more.

TABLE 19
Intensity of Cropping of Bluegrass by Deer by Plots
All Types

Average percent cropping class	Spring, 1949, number of plots	Percent
0- 4.9-----	194	73
5- 9.9-----	36	14
10-14.9-----	17	6
15-19.9-----	6	2
20 plus-----	14	5
Totals-----	267	100

Idaho fescue: Although the management plan has listed Idaho fescue as the key herbaceous species for livestock in the sagebrush and juniper range types, use of this grass was less than use of June grass (*Koeleria cristata*), needle grass (*Stipa* spp.) and bluegrass in the sagebrush type, and less than needle grass, bluegrass, and rye grass (*Elymus* spp.) in the juniper type during 1948. Whether the different degrees of cropping found in 1948 differ from those of 1947 because of the unusual grass growth of 1948, or because of more adequate sampling, cannot be determined until data for a longer series of years is at hand (see Table 20).

TABLE 20
Average Percentage Cropping of Idaho Fescue

Type	1947			1948			1949
	*Deer	Live- stock	Total	Deer	Live- stock	Total	Deer
Sagebrush-----	0.1	24.5	24.6	.0.1	8.9	9.0	3.1
Juniper-----	0.6	22.6	23.2	0.6	9.2	9.8	2.8

* 1948 spring data has been used here for lack of data for spring, 1947; total cropping is actual estimate made in fall, 1947.

Squirreldtail: Cropping data on squirreldtail grass is given in Table 21 for the grassland type, where it is considered the key herbaceous species for livestock. Cropping of early spring growth of this grass species by deer rose from 1.7 to 5.2 percent.

TABLE 21
Average Percentage Cropping of Squirreldtail Grass
Grassland Range Type

1947			1948			1949
Deer	Livestock	Total	Deer	Livestock	Total	Deer
1.7	19.5	21.2	1.7	13.2	14.9	5.2

Sagebrush and rabbitbrush: Although neither sagebrush or rabbitbrush are considered key forage plants, it is interesting to compare the cropping data given in Tables 22 and 23 in the light of the increased number of deer on the winter range during the 1948-49 season.

TABLE 22
Average Percentage Cropping of Rabbitbrush

Range type	1947-48			1948-49			
	Livestock	Deer	Total	Livestock	Deer	Rodents	Total
Pine-bitterbrush.....	1.1	7.0	8.1	1.6	3.7	1.9	7.2
Sagebrush.....	0.0	0.9	0.9	2.3	6.3	6.6	15.2
Juniper.....	0.3	1.5	1.8	1.7	8.3	1.9	11.9
Grassland.....	0.8	6.6	7.4	2.9	7.8	11.2	21.9

TABLE 23
Average Percentage Cropping of Sagebrush

Range type	1947-48			1948-49			
	Livestock	Deer	Total	Livestock	Deer	Rodents	Total
Pine-bitterbrush.....	0.0	3.3	3.3	0.1	1.5	0.0	1.6
Sagebrush.....	0.2	0.7	0.9	0.3	2.4	0.6	3.3
Juniper.....	0.4	1.3	1.7	0.3	7.5	0.8	8.6
Grassland.....	0.1	0.8	0.9	0.0	3.9	0.0	3.9

The great increase in use of these shrubs by deer during the 1948-49 season is a reflection probably first of all of increased deer numbers, but also of restricted movement of deer resulting from the heavier snow fall of last winter. Data on rodent cropping, which was distinguished

and recorded for the first time last season, is indicative of the high jack-rabbit population which was present on the winter range.

Table 24 gives percentage cropping of various plant species by livestock and deer in the pine-bitterbrush type.

TABLE 24
Deer-livestock Cropping in Pine-bitterbrush Type
Interstate Winter Deer Range
(Based on 100 plots: 50,000 inches of line intercepts)
Average Percentage Cropping

Species	Livestock	Deer†	Rodents	Total
Browse Plants				
Artemisia spp.	0.1	1.5	-----	1.6
Ceanothus prostratus	0.2	0.2	-----	0.4
Cercocarpus ledifolius	1.2	3.4	-----	4.6
Chrysothamnus spp.	1.6	3.7	1.9	7.2
Juniperus occidentalis	0.0	21.8	-----	21.8
Juniperus occidentalis, offplot	0.0	12.8	-----	12.8
Prunus spp.	31.9	0.0	-----	31.9
Purshia tridentata	21.6	19.9	-----	41.5
Grasses and Forbs				
Grasses and Grasslikes				
Agropyron spicatum	1.5	2.5	4.0	0.1
Carex spp.	1.0	2.1	3.1	1.2
Festuca idahoensis	0.5	6.8	7.3	0.2
Koeleria cristata	4.6	6.6	11.2	0.7
Poa spp.	4.3	10.4	14.7	2.1
Sitanion hystrix	1.5	3.4	4.9	0.5
Stipa spp.	0.2	7.7	7.9	0.2
Forbs				
Achillea spp.	0.0	0.3	0.3	0.0
Antennaria spp.	0.0	2.3	2.3	0.0
Balsamorhiza spp.	0.0	19.7	19.7	0.0
Wyethia mollis	0.0	7.4	7.4	0.0

† Spring, 1949.

* Spring, 1948.

Proposed Management Area

In the third progress report (Interstate Deer Herd Committee, 1949a) data was presented which indicated there occurred on the Interstate winter deer range an area on which cropping of key forage species by deer was much heavier than elsewhere on the range. The more adequate sample secured during the 1948-49 season suggests certain minor changes in the boundaries of this area. These boundaries have been rather loosely drawn to accommodate shifts in deer concentration that result from weather. Consequently the proposed management area does include portions of the range on which deer use may be light during some winters. The plot data indicates that approximately 64 percent of the total bitterbrush stand is inside the proposed management area boundaries.

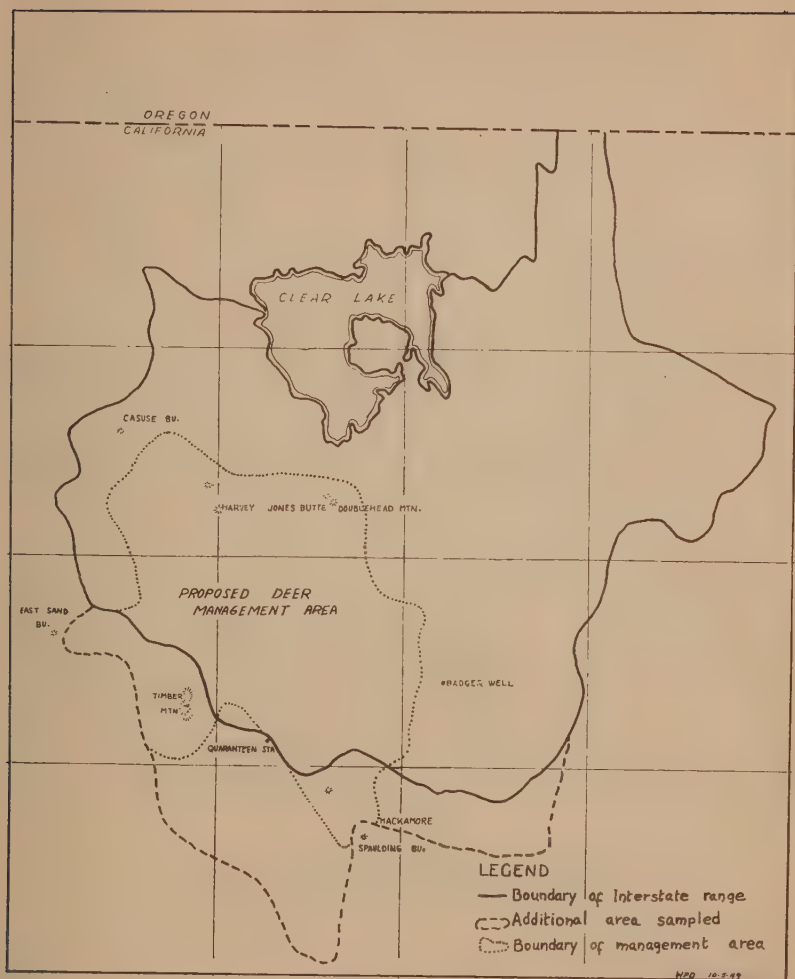


FIGURE 10. Proposed deer management area. Also shows location of additional area sampled by forage and pellet group checks.

In Tables 25, 26, and 27 presented below, compilation of the 1947-48 data has been adjusted to include the plots within the amended boundaries mentioned above.

A comparison of data from inside the proposed deer management area indicates that cropping of bitterbrush by deer during the 1948-49 season increased 43 percent over that of 1947-48. Cropping by livestock decreased 5 percent.

TABLE 25
Average Percentage Cropping of Bitterbrush
Inside and Outside Management Area

	1947-48			1948-49		
	Livestock	Deer	Total	Livestock	Deer	Total
Inside key area.....	18.8	20.2	39.0	17.8	29.0	46.8
Outside key area.....	21.5	11.5	33.0	19.6	8.0	27.6
Over entire range.....	20.1	16.2	36.3	18.4	21.5	39.9

It should be emphasized, however, that there are places outside the management area where cropping of bitterbrush and other vegetation species by livestock is excessive. The management area boundary is an attempt to define that portion of the winter range on which deer cropping is heaviest, i.e., the portion of the range where deer concentrate during midwinter months. Because the forage which it supports is vital for the sustenance of the deer herd during these months, it is suggested that deer numbers be kept in balance with the allowable crop of forage produced on this critical area.

An analysis of average percentage cropping for plots inside the management area indicates that 10 percent of the plots showed an average use of 60 percent or more when livestock left the range in the fall. When deer left in the spring 45 percent of the plots in the management area showed an average use of 60 percent or more. This may be compared with data from the previous year when 14 percent of the plots were browsed 60 percent or more when livestock left the range and 45 percent were so browsed when deer left the following spring. It will be noticed that more plots fell into the 75-89.9 class and that one plot moved up into the 90 plus class as a result of the heavy use last season.

TABLE 26
Intensity of Cropping of Bitterbrush by Plots
Inside Proposed Deer Management Area

Average percent cropping class	1947-48				1948-49			
	Fall		Spring		Fall		Spring	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
0-14.9.....	10	48	0	0	24	56	5	12
15-29.9.....	4	19	5	25	4	10	9	21
30-44.9.....	3	14	4	20	6	14	5	12
45-59.9.....	1	5	2	10	4	10	4	10
60-74.9.....	3	14	6	30	2	5	10	24
75-89.9.....	0	0	3	15	2	5	8	19
90 plus.....	0	0	0	0	0	0	1	2
Total.....	21	100	20	100	42	100	42	100

Since the area on which it is thought practical to sacrifice bitterbrush has been excluded from the sample, the size of the bitterbrush area (as reflected by the number of sample plots) on which damaging use has occurred should be given consideration in setting deer and livestock population ceilings at the end of the three-year sampling period.

Statistical analysis of the bitterbrush sample from the management area shows a mean percentage cropping of 49.3 ± 4.1 , with a standard deviation of 27.0 and a standard error of the mean of 4.1. This indicates the probable error in sampling is less than 9 percent.

Cropping of terminal twigs of juniper trees inside the management area last season increased 82 percent over the season previous. The percentage of plots on which juniper occurs and on which cropping was in excess of 40 percent of the twig growth rose from 5 percent during 1947-48 to 20 percent during 1948-49. This is shown in the tables below:

TABLE 27
Average Percentage Cropping of Juniper Trees Inside and Outside
Proposed Deer Management Area

	1947-48			1948-49		
	Number plots	Number trees	Average percent crop	Number plots	Number trees	Average percent crop
Inside key area.....	21	29	15.4	40	57	28.1
Outside key area.....	8	9	9.9	19	26	10.0
Total.....	29	38	14.0	59	83	22.2

Intensity of Cropping of Juniper by Plots
Inside Proposed Deer Management Area

Average percent cropping class	1947-1948		1948-1949	
	Number plots	Percent	Number plots	Percent
0- 9.9.....	9	43	5	13
10-19.9.....	2	9	9	22
20-29.9.....	7	34	13	32
30-39.9.....	2	9	5	13
40-59.9.....	1	5	5	13
60-79.9.....	0	0	1	2
80 plus.....	0	0	2	5
Total.....	21	100	40	100

Statistical analysis of the juniper sample from the management area shows a mean percentage cropping of juniper of 28.9 ± 3.2 , with a standard deviation of 19.5 and a standard error of the mean of 3.2. This indicates the probable error in sampling is around 11 percent.

A comparison of the utilization of sagebrush inside and outside of the management area indicates that average percentage cropping was

9.1 percent inside and 1.5 percent outside. An analysis presented in the third progress report (Interstate Deer Herd Committee, 1949a) indicated that rabbit-brush was cropped 7.7 percent inside the management area and 2.3 percent outside.

Recommendations

(1) It is recommended that the proposed deer management area be accepted as the area most critical to the survival of the deer herd, and that management of the deer herd be based on the allowable crop of forage on that portion of the range.

(2) The job of estimating percentage cropping of all plant species on all plots runs around 30 man-days of work twice yearly. The compilation of all of this data, together with its summation in the final report, takes nearly as much time again. While the expenditure of this time is justified on a basic study, it is believed out of line for practical management year after year. To reduce the time expended on field checks and office compilation to within practical limits, the following recommendations are offered:

(a) It appears after two years of study, which include both a light and a heavy winter, that the cropping of the early spring growth of grasses and forbs by deer is generally so light as to be relatively unimportant in the range maintenance picture. Cropping by livestock has been less than the allowable use for the species concerned. It is recommended that further checks on cropping of all grass species be discontinued.

(b) It is recommended that utilization checks on browse species other than bitterbrush and juniper be confined to the plots on which these two key species occur.

(c) It is recommended that utilization checks on juniper be confined to those plots on which juniper occurs within the proposed deer management area.

(d) It is recommended that utilization checks on bitterbrush be confined to that portion of the range inside the proposed deer management area on which bitterbrush is considered a key browse species, and to such adjacent areas where a check on livestock use is desired.

SUMMARY

The important factors brought out in the various field studies of the interstate deer herd and its range during the 1948-49 season may be summarized as follows:

1. The strip census indicates an increase in deer numbers of 140 percent over the previous year. The computed number of animals jumped from 9,800 to 23,400 head. The increase is explained by (1) the heavy snowfall which pushed all the deer from contributory ranges in California and Oregon into the counting area and (2) a fawn survival heavier than any other recorded during the course of the cooperative study.

2. The state line track count jumped to 14,011 head in 1948-49. This was an increase of 45 percent over the 9,665 deer counted the previous year. The field workers consider this count the minimum number for the deer herd migrating from the winter range into Oregon. They concede that the actual number may be several thousand greater.

3. The pellet group count (using a ratio of 12.7 pellet groups equals one deer day) indicates that deer use during the winter of 1948-49

totaled approximately 5,300,000 deer days. This is an increase of 37 percent over the figure of last year, viz. 3,860,000 deer days. The data indicates there were more deer on the range for a shorter period than was the case during the 1947-48 season. The total number of deer on the winter range for an average 184-day period during the 1948-49 season, as computed from the pellet count, was 28,800 animals. This is a 44 percent increase over the previous years computed population of 20,000 animals which were on the range for an average of 192 days.

4. The forage studies showed a 33 percent increase in the over-all average cropping of bitterbrush by deer during the 1948-49 winter season. There is a close, though perhaps coincidental, agreement between this figure and the increase in deer days of use of 37 percent shown by the pellet group data. Over-all cropping of bitterbrush by livestock decreased 8 percent. Total average percentage cropping was 39.9 percent. Under this level of cropping 34 percent of the bitterbrush sample plots showed average cropping of 60 percent or more when the deer left the range in the spring.

Over-all percentage cropping of juniper twigs by deer increased 58 percent over the previous year to an average of 22.2 percent. Under this level of cropping 13 percent of the juniper sample plots showed an average percentage cropping of 40 percent or more.

On the proposed deer management area, total percentage cropping of bitterbrush averaged 46.8 percent of which deer consumed 29.0 percent. This is compared with the areas outside the management area, where total percentage cropping averaged 27.6 percent and deer consumed 8.0 percent. These averages represent an increase in cropping of bitterbrush by deer of 43 percent and a decrease by livestock of 5 percent. Under this level of use, 45 percent of the bitterbrush plots inside the management area showed an average cropping of 60 percent or more.

Inside the management area total percentage cropping of juniper twigs by deer averaged 28.1 percent as compared with 10 percent outside this area. Under this level of use 20 percent of the juniper plots inside the management area showed average cropping of 40 percent or more.

ACTION PROGRAM

After a consideration of the data presented above the Interstate Deer Herd Committee agreed that:

1. Management of the winter deer herd should be based upon the management area shown by the pellet group counts and the forage utilization checks.

2. Forage utilization checks and pellet group counts will be limited to the management area, except when data on livestock cropping of bitterbrush is desired for areas outside. Only browse species will be checked for utilization.

Because deer numbers are increasing and because the current level of cropping of key forage species is causing damage to the forage resource, the Interstate Deer Herd Committee recommended that the California Fish and Game Commission set a season for antlerless deer in the Fall of 1950. If a reduction in animals is necessary, the number will be recommended next spring and will be based on a three-year average of cropping of key forage species as provided in the interstate winter deer range management plan (Interstate Deer Herd Committee, 1949b). The final check on forage utilization will be made in the spring of 1950.

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NOTES

SMALL BOAT STABILIZERS

The otterboard principle is having a new application among the salmon trolling vessels of Northern California. Some 80 years ago otterboards were first used by European sport fishermen to carry a fishing line out away from the skiff and later commercial fishermen used boards to keep open the mouth of a dragnet or trawl. For several years past, some of our salmon trollers have been using a horizontal sheerboard in place of heavy lead weights to keep their lines and hooks submerged at the desired depth. In the last few months the otterboard principle has been used as a device for holding a fishing vessel steady by reducing the roll of the boat in heavy seas. The use of this simple gadget is said to increase the fish catch of the boat by permitting fishing in rough seas that would otherwise drive the small trolling vessels to shelter.

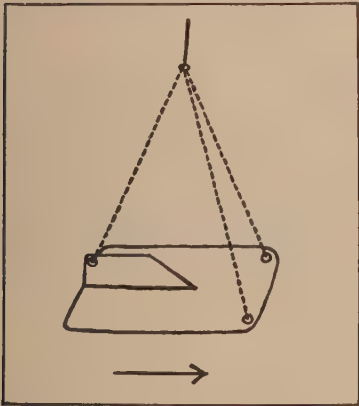


FIGURE 11. Small boat stabilizer.

The device consists of two horizontal boards, one on each side of the vessel, carried 6 to 20 feet under water with the flat surface of the board parallel to the surface of the water. When the vessel rolls to one side the flat surface of the opposite board partially checks the roll. This checking action of the boards is exerted even when the vessel is at anchor. The boards usually are hung from the main outrigger troll poles which are carried a little forward of amidships. While the vessel is under way, the boards ride a little aft of amidships. The supporting line from board to pole is made fast to the pole

about one-half to two-thirds of the way out toward the pole tip. This means that each board is carried 10 to 18 feet out from the side of the vessel and this provides for considerable leverage on the vessel through the outrigger pole. Because of this leverage it usually is necessary to outfit the vessel with heavier outrigger poles or to support the poles with heavier guyline braces.

A few boards are of wood but most are of metal. Many are home-made or made to order at a metal worker's shop and some are sold by ship chandlers. Boards vary in size and shape but are roughly one and a half to two feet long by 12 to 16 inches wide with the forward edge rounded at the corners. Most boards are supported by three short bridle chains, two from the forward edge and one from the aft end. On the underside of the forward edge there is usually a heavy lead weight to keep the board down in the water and the supporting line taut. On the upper surface of the board is welded a vertical fin or vane which serves to keep the board headed on the same course as the vessel.

These stabilizer boards (often called flipper flappers) are said to have been used during 1948 in Washington and Oregon but they were not introduced into California till the early part of 1949. By the middle of June, 1949, eight or ten troll boats at Eureka were using stabilizers. By mid-August more than half the trollers at Eureka and Fort Bragg were equipped with stabilizing boards, and five or six pairs of boards were in use at San Pedro before the end of August 1949.—*W. L. Scofield, Bureau of Marine Fisheries, California Division of Fish and Game, August, 1949.*

IN MEMORIAM
ABE WOODARD

Abe Woodard, retired, an employee of the Bureau of Fish Conservation for over 20 years, succumbed to a heart attack September 15, 1949. During his employment by the division, Mr. Woodard was stationed at the Central Valleys Hatchery, Elk Grove, and for several years directed fish rescue activities in the Central Valleys area.—*Earl Leitritz, Bureau of Fish Conservation, California Division of Fish and Game, October, 1949.*

IN MEMORIAM
CHARLES S. BAUDER

Charles S. Bauder passed away in Sacramento on Wednesday, September 28, 1949.

He retired from active service with the Bureau of Patrol on July 1st, having reached the required age. He had suffered poor health for the past year, although his condition was not considered serious until just prior to his death.

Bauder joined the Division of Fish and Game in 1914 in San Luis Obispo County. In 1927 he was appointed to Assistant Chief of Patrol in the Los Angeles district, and in 1941 was transferred to the Sacramento Division.

Bauder was a member of the Masonic Order and numerous other organizations. Survivors are his wife; a son, William C. Bauder; and a brother, W. R. Bauder of Sonoma, to whom we express our sincere sympathy.—*L. F. Chappell, Bureau of Patrol, California Division of Fish and Game, December, 1949.*

REVIEWS

United States Mollusca. A descriptive manual of many of the marine, land and fresh water shells of North America, north of Mexico

By Walter Freeman Webb, Rochester, New York, 1942, 220 pp., 63 pls. \$5.00.

A collector's handbook for amateur conchologists. Most of the common species are illustrated by photographs or pen and ink drawing. The descriptions do not describe very much, sometimes consisting of the name of the species and its geographical range. Scattered through the book are many little notes on a variety of subjects; collecting, life history, commercial uses, etc.; and the information that the author has for sale various and sundry shells and literature. The book is merely a grandiose catalog.—*Paul Bonnot, California Division of Fish and Game.*

REPORTS

FISH CASES

July, August, September, 1949

Offense	Number arrests	Fines imposed	Jail sentences (days)
Angling: Closed stream; 2 attractor blades at night; no license; chumming; transfer of license; using borrowed license; nonresident using resident license; using illegal minnow net in District 1; using set lines in a closed stream at night; 2 lines; seining; near dam; fail to show license on demand; trespassing to fish.	368	\$6,377 00	12
Abalones: Overlimit; undersize; out of shell; no license.	112	3,182 00	100
Chumming: Using salmon eggs.	6	160 00	
Crabs: Undersize.	4	100 00	
Perch: No license.	1	10 00	
Bluegill: Overlimit.	1	20 00	
Striped Bass: Undersize; overlimit; set line; no license; using borrowed license; 2 lines; illegal possession of striped bass.	150	4,232 00	
Pollution: Sawdust.	2	350 00	
Trout: Overlimit; closed season; set line; chumming; snagging; no license.	77	2,548 00	
Lobster: Closed season.	8	525 00	
Catfish: Illegal sale; undersize; using fyke nets in a closed season; no license; possession of a fish spear.	6	395 00	
Commercial: Failure to submit a production report; no party boat license; no license; round haul net in closed district; fail to keep records; boat improperly numbered.	47	1,150 00	
Clams: Overlimit; undersize; possession for commercial use; night-digging; no license.	83	3,390 00	
Salmon: Undersize; possession gill netted salmon; possession untagged salmon; closed season; no commercial license.	3	100 00	
Cockles: Overlimit.	1	15 00	
Sunfish: No license.	2	200 00	
Yellowfin Tuna: Sale of undersized yellowfin tuna.	12	825 00	
Albacore: Sale of undersized albacore.	1	25 00	
Frogs: Undersize.	2	50 00	
Barracuda: Overlimit.	1	25 00	
Yellowfin Croaker: Overlimit.	1	15 00	
Totals.	888	\$23,694 00	112
Court forfeitures: (Confiscated fish)		\$2,563 49	

GAME CASES

July, August, September, 1949

Offense	Number arrests	Fines imposed	Jail sentences (days)
Deer: Spike buck; using borrowed tags; doe; spotlighting; unvalidated tags; possessing a fawn; closed season; using full metal jacketed bullets; overlimit; failure to show game on demand; fail to keep hide and horns of deer; possessing parts of illegally taken deer; failure to fill out tag properly; transporting deer for purpose other than to have tag countersigned; possessing deer and firearms in a refuge; altered deer tag; taking deer legally in possession of another; mutilating and destroying tag; possession forked-horn in District 134; possession deer skin with evidence of sex removed; closed season; no deer tags; night hunting; using .22 caliber rifle; no license; using borrowed license.	225	\$22,292 00	780
Deer Meat: Closed season; possessing unstamped meat.	33	4,125 00	20
Hunting: Firearms in refuge; no license; night hunting; trespassing; shooting from the road; spotlighting; unplugged gun; shooting from a car; transferring license and tags; closed season; failure to show license.	135	8,548 00	6
Doves: Closed season; hunting with a shotgun capable of holding more than three shells; hunting after legal shooting hours; overlimit; unplugged gun; shooting from a car; no license; shooting from the road; using a .22 caliber rifle.	80	2,600 00	37
Ducks: Closed season; late shooting.	19	715 00	
Geese: Closed season.	6	120 00	
Pheasants: Using a .22 caliber rifle; closed season; hen; shooting from a car; no license.	40	3,375 00	
Rabbits: Closed season; spotlighting; unplugged shotgun; no license; shooting from a car; night hunting; shooting a cottontail; possession and transporting illegal game into California.	31	825 00	
Quail: Closed season; illegally taken in Mexico; valley quail in closed season; mountain quail in closed season; no license; trapping quail in September.	18	1,115 00	
Pigeons: Closed season.	5	205 00	
Commercial: No breeder's license.	1	25 00	
Bear: Closed season.	2	150 00	
Grouse: Possession.	1	35 00	
Squirrels: Illegal possession; no license; closed season.	2	35 00	
Antelope: Closed season.	1	250 00	
Sage Hen: Possession.	4	635 00	
Totals.	603	\$45,050 00	843

SEIZURES OF FISH AND GAME

July, August, September, 1949

Fish:	
Abalone.....	728
Albacore.....	17
Perch.....	5
Bass.....	811
Barracuda.....	14
Crabs.....	111
Crabs, pounds.....	200
Skipjack tuna, pounds.....	7,198
Yellowfin tuna, pounds.....	72,583
Clams.....	3,164
Catfish.....	32
Catfish, pounds.....	16
Trout.....	1,387
Trout, pounds.....	4
Sunfish.....	21
Lobsters.....	16
Bluegill.....	27
Cockles.....	862
Yellowfin Croaker.....	20
Pacific Mackerel, pounds.....	1,675
Salmon.....	5
Salmon, pounds.....	250
Frogs.....	11
Game:	
Deer.....	148
Deer Meat, pounds.....	659½
Rabbit.....	51
Antelope.....	1
Sage hen.....	2
Pheasant.....	60
Shorebirds.....	1
Squirrels.....	2
Non-Game.....	6
Doves.....	525
Pigeons.....	7
Grouse.....	2
Geese.....	2
Quail.....	38
Ducks.....	57
Bear Meat, pounds.....	20

